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ALIEN PROPERTY CUSTODIAN

YARN GUIDE

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Application filed March 14, 1941

The invention relates to a yarn guide which is fixed on a ring carrying out a drunken movement and ensured against individual rotation. To the yarn guide, oscillation is thus imparted owing to the drunken movement. In the known arrangements, the ring, which is mostly disc-shaped, is mounted on a separate shaft which extends coaxially with the shaft carrying the oblique disc from which the drunken or oscillating movement is derived. Occasionally it is found also that the two shafts are arranged mutually displaced in order that the stroke can be adjusted. But in any case a number of articulations, connecting pieces and the like are required to enable the power transmission.

Compared herewith, the ring which carries the yarn guide or the yarn guides is mounted, according to the invention, on a circular disc or in a circular groove which in turn is obliquely mounted in the driving shaft. In this arrangement, not only the second shaft is omitted but also any additional element for transmitting the oscillating movement upon the yarn guide. Consequently any desired speed at absolutely silent movement can be imparted to the yarn guide. In the construction according to the invention it is further possible for the first time, to impart an oscillating movement by means of oblique discs to any number of yarn guides, especially to the known auxiliary yarn guides in winding machines with driving drums having crossed grooves.

The mounting of the ring according to the invention is known as such. But in the known cases of employment it serves for quite other purposes.

Over the ring an oscillating bow grips, according to the invention, cardan-like, which means cross-hinge-like, the oscillating axis of this bow extending through the centre of disc or groove, whereby an especially simple securing against turning is attained, especially also when two yarn guides are arranged opposite the one to the other as known. As the stressing of the ball bearings owing to the drunken movement as such would take place in two axial directions, the invention provides further an one-sided preliminary tensioning of the bearing, so that the bearing is loaded only in one axial direction and thus any leakage in the bearing is avoided.

The arrangement of the oscillating bow enables besides also the actuation of several yarn guides from one and the same oblique disc in such a manner that the yarn guides are arranged on the correspondingly lengthened oscillating shaft of the bow.

According to the invention, yarn guide, axis of the driving shaft and of the guide roller may be situated in the same plane or in different planes which intersect in the axis of the driving shaft. In the latter instance the yarn guide carries out a 8-shaped movement, whereby, when the yarn guide is used as auxiliary yarn guide, the moving of the yarn on the crossing points of the grooves is favored.

Several embodiments of the invention are illustrated by way of example in the accompanying drawing, in which:

Figs. 1 and 2 show in top plan view and side elevation the arrangement of a yarn guide on a ring gripping over the oblique disc.

Figs. 3 to 5 different arrangements of the guiding of the yarn guides by means of a ring gripping over the oblique disc and mounted in an oscillating bow, the oscillation axis of which extending through the centre of the oblique disc,

Fig. 6 shows the loading of two oscillating bows by one and the same spring,

Fig. 7 the arrangement of several yarn guides on the shaft of an oscillating bow,

Fig. 8 an other mounting of the ring on the oblique disc,

Fig. 9 in front elevation an other form of construction,

Fig. 10 is a side elevation of Fig. 9, and

Fig. 11 shows in elevation on larger scale the grooved drum.

As shown in Figs. 1 to 6, the yarn guide serves as auxiliary yarn guide in quick traverse winding frames in which the yarn laying is effected by means of the known driving drum having crossing grooves, whereas the embodiments illustrated in Figs. 7 and 8 explain the employment of the yarn guide on cop winding machines.

The cross-wound bobbin S is driven by means of the grooved drum 1 through the intermediary of the toothed wheels 2, 3 from the shaft 4, which shaft serves at the same time for driving the yarn guide or yarn guides. The shaft 4, the shaft 5 for the grooved drum, or both drums may be common for several winding points.

The hub of the oblique disc 6 is keyed on shaft 4, a ring 7 bearing, with intersection of a ball bearing 7a, on said disc, the yarn guide 8 and, in the extension of its axis passing through the centre of disc 6, a guide roller 9 are mounted. The roller 9 is pressed by a spring 11 against a guide piece 10, said spring preventing further the ring 7 from turning in the direction of rotation of the oblique disc 6. The laying of the yarn F by means of the yarn guide 8 and grooved

drum 1 is effected in a generally known manner.

In the embodiment shown in Figs. 3 to 6, open bearing eyes 13 of an oscillatable bow 12 engage over the yarn guides 8 extending from opposite sides of the ring 7, the pivot point 14 of said oscillatable bow being journalled perpendicularly to the shaft 4 and so that its axis extends through the centre of disc 7. A spring 16 exerts a pull upon the oscillatable bow 12 and therewith upon the ring 7 or the ball bearing 7*a* carrying the yarn guides, so that a one-sided preliminary tension is produced. Fig. 3 shows how the transmission of the drunken movement known as such can be utilized for the simultaneous actuating of two yarn guides which cooperate with grooved drums mounted on opposite sides.

The preliminary loading of the oscillatable bows 12 or of the ball bearing 7*a* can be simplified, as illustrated in Fig. 6, in that every two oscillatable bows 12*a* and 12*b* are coupled by the same spring. This is possible without any difficulty if the bows with their open bearing eyes directed the one towards the other or the rings 7 are pressed now from the right and then from the left over the oblique disc 6, as in this instance the preloaded axial forces balance the one the other.

The derivation of the oscillating movement of any number of yarn guides from one and the same oblique disc is illustrated in Fig. 7. The pivot pin 14 of the oscillating bow 12 is, with this object in view, replaced by a shaft 18 of corresponding length on which the yarn guides 19 are fixed. These yarn guides serve for building up cops K which according to the progressing building up are axially pushed away in usual manner by the yarn guides. This arrangement may be applied in a similar manner also for quick traverse winding frames, that is in such machines in which the traverse winding spindles are mounted at right angles to the longitudinal axis of the machine and parallel the one at the side of the other. It is then immaterial whether the corresponding cross-wound bobbins are driven by circumferential friction, as shown in Figs. 1 and 2, or by direct spindle drive.

Another mounting of the yarn guides than in the above described embodiments is illustrated in Fig. 8 for a tubular cop winding machine. From the winding spindle 22 the oblique disc 25 is driven through the intermediary of spur wheels 23, 24, and the ring 26 carrying the yarn guide 27 is clamped between ball bearings, said ring, similar as in the embodiment illustrated in Figs. 1 and 2, sliding along a guide 28 and being thereby secured against turning. The yarn guide 27 moves over the slit of the pointed funnel 21 also in a generally known manner.

The embodiment shown in Figs. 9 and 10 corresponds substantially to that shown in Fig. 1 and 2, with the exception however that the shaft 4 is situated below shaft 5 but displaced in lateral direction, and the yarn guide 8 is not located in the plane determined by shaft 4 and roller 9 but laterally adjacent the ring 7 in a plane which intersects in the axis of shaft 4 with the plane determined by shaft 4 and roller 9. The eye 8*a* of the yarn guide 8 is in this embodiment bent upwards in the direction to the drum 1. In this manner it is attained that the eye 8*a* moves along an 8-shaped curve 30, as shown in Figs. 9 and 11, the accuracy of the yarn guiding being increased thereby particularly at the passing over the crossing points of the grooves. In Fig. 11 the yarn positions due to the yarn guide 8 at different points of intersection of the grooved drum are shown so that the dash lines indicate the position of the yarn F without utilisation of the additional movement 30 and the full lines that position into which the yarn is brought by the yarn guide 8 when the same carries out the 8-shaped additional movement, which shows that the yarn securely passes the point of intersection, so that it is possible to operate at higher speed without the danger of a wrong moving of the yarn. The ratio of transmission between yarn guide 8 and grooved drum 1 is 1:3; at 60° rotation of the yarn guide 8, the grooved drum 1 therefore carries out a rotation of 180°, which means the way up to the next following crossing. The left hand and right hand extreme position has been reached by the yarn guide by 15° sooner than the yarn in the grooved drum.

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Fig. 1

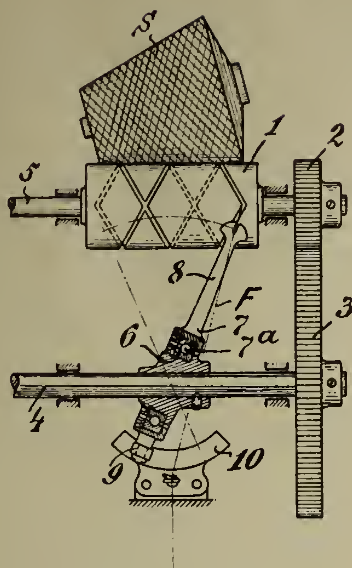

Fig. 2

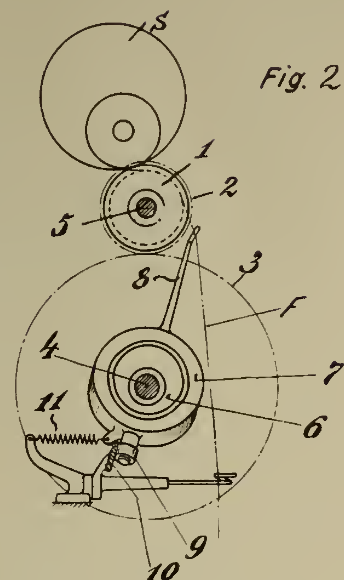

Fig. 3

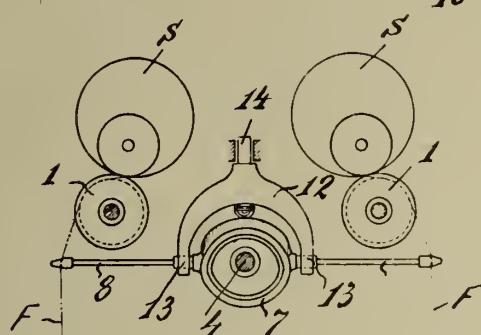

Fig. 4

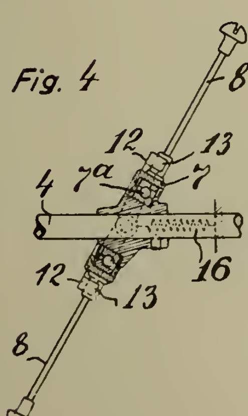

Fig. 5

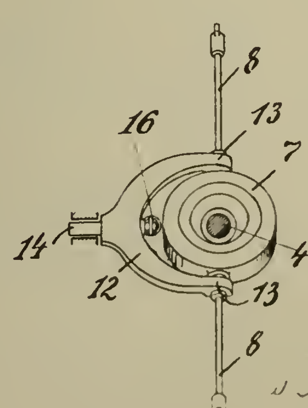

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Fig. 6.

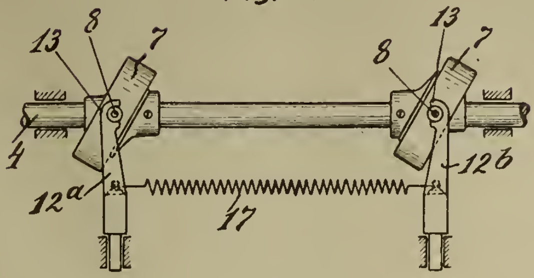

Fig. 7.

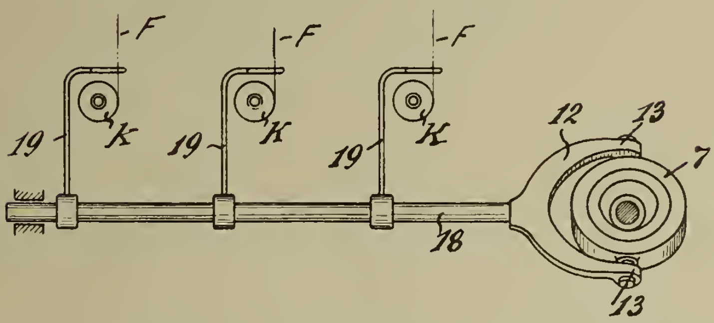

Fig. 8.

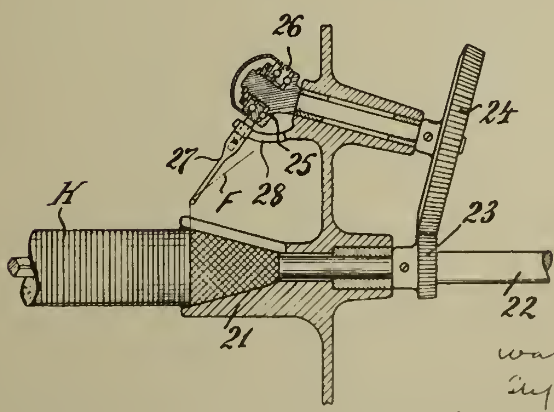

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Fig. 9.

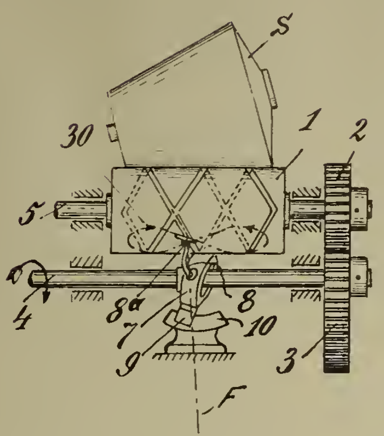


Fig. 10

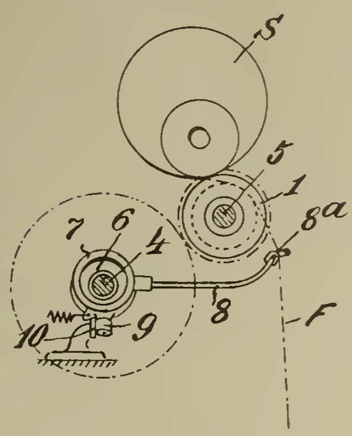
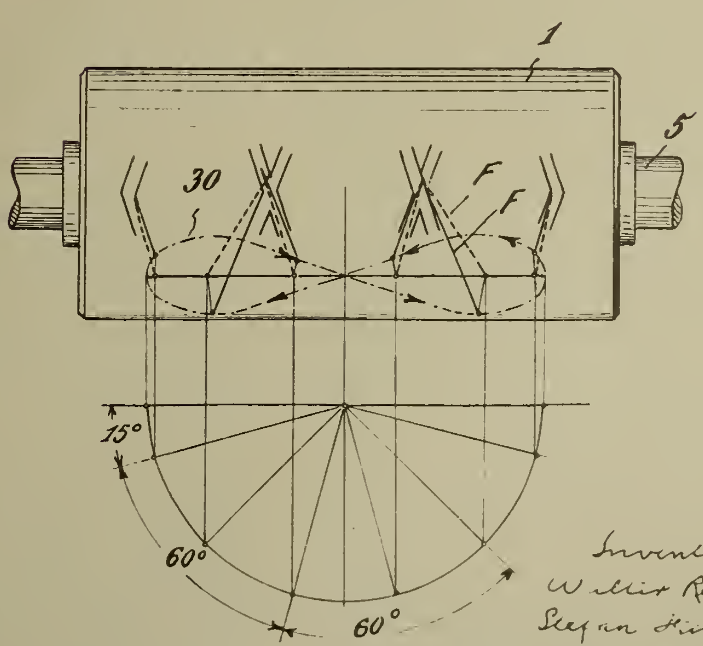


Fig. 11.



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ALIEN PROPERTY CUSTODIAN

ADDING MACHINE

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This application is a continuation of application Serial Number 224,630 filed August 12, 1938.

This invention relates to an adding machine with which is combined a multiplying arrangement capable of operating by shortened multiplication.

It is well known that multiplying can be done on adding machines by adding repeatedly the value set up as by actuating the repeat key and pressing down the motor key repeatedly. This method of operating, however, requires keen attention on the part of the operator, and experience has demonstrated that it is not carried out without calculating errors. In order to overcome these difficulties a so-called multiplier setting mechanism has been provided on the adding machine and by means of this the "repeat" additions were carried out automatically by pressing a suitable key.

However, this did not provide means for utilizing the adding machine for large scale multiplication operations, because the adding machine, as a result of the oscillatory movements of its principal parts, was too slow in operation for the purpose intended.

It is an object of the present invention to adapt an adding machine notwithstanding its relatively slower operation for use as a multiplying machine. The multiplier setting mechanism according to the present invention is arranged so that the values above 5 are calculated by shortened multiplication.

A further object of the invention is to provide a particularly simple construction wherein a shifting member actuated by the multiplier setting mechanism acts on the stem of the motor key by means of an intermediate member such as a lever or the like.

A further object of the invention is to provide an arrangement wherein the shifting means of the multiplier setting mechanism, which determines whether addition or subtraction is to be used, is connected with the means of the adding machine for reversing the calculating mechanism gears so as to set them for the desired addition or subtraction.

The accompanying drawings show an example of the invention. Referring to the drawings:

Figure 1 is a partial side view of the invention with the cover plate removed.

Figure 1*a* is a continuation of the view shown in Figure 1 and to the right thereof.

Figure 2 is a partial plan view with a portion of the cover plate removed.

Figure 2*a* is a continuation of the view in Figure 2 and to the right thereof.

Figure 3 is a cross sectional view taken on the section line III—III of Figures 2 and 2*a* with parts broken away and omitted for greater clarity.

Figure 4 is a cross sectional view taken on the section line IV—IV of Figures 2 and 2*a* looking in the direction of the arrows and with portions omitted for greater clarity.

Figure 5 is a horizontal cross sectional view taken on the section line V—V of Figure 3 with portions omitted for greater clarity.

Figure 6 is a cross sectional view illustrating particularly the connections with the motor key and the means for securing the step-by-step return motion of the ratchet wheel.

Figure 7 is a cross sectional view of the multiplier setting mechanism in initial position.

Figure 8 is a cross sectional view similar to Figure 7 but with some of the parts omitted for greater clarity illustrating the position of the parts when the multiplier setting key "2" is depressed with a further showing in dot-dash lines showing the position of some of the parts after the key "2" has been released and has moved upwardly to the position shown in Figure 8*a*.

Figure 8*a* is a view of a portion of Figure 8 showing the position of key "2" after being depressed and released so as to return part way to its original position.

Figure 9 is a view similar to Figure 7 with parts omitted for greater clarity illustrating the position assumed by certain elements when the multiplier setting key "6" is depressed.

Figure 10 is also a view similar to Figure 7 with parts omitted for greater clarity illustrating the position taken by some of the parts when the multiplier key "0" is depressed.

Figure 11 is a view similar to Figure 7 with some of the parts omitted for greater clarity illustrating the position assumed by various elements when the multiplier setting key "9" is depressed.

Figure 12 is also a view similar to Figure 7 with parts omitted for greater clarity illustrating the position taken by some of the elements when the multiplier setting key "2" is depressed with the controls however in a different position from that shown in Figure 8.

Figure 13 is a partial cross sectional view similar to that shown in Figure 10 with parts omitted for greater clarity and other cooperating parts inserted in order to more clearly show the operation between such cooperating parts.

Figure 14 is a cross sectional view taken on

the section line XIV—XIV of Figure 7 looking in the direction of the arrows and illustrating the particular controls for the multiplier setting keys "0" and "9."

Figure 15 is a similar view to Figure 14 showing the parts in a different position.

Figure 16 is a cross sectional view taken on the section line XVI—XVI of Figure 7 and looking in the direction of the arrows illustrating particularly the control means for the reversing of the calculating or counting gears and the control for the means governing the step by step movement of the ratchet shifting means.

Figure 17 is a partial perspective view illustrating the construction of a control tube and cooperating U-shaped bars determining the step-by-step movements to be given to the ratchet shifting wheel in accordance with the particular multiplier setting key depressed, and

Figure 18 is a cross sectional view taken on section line XVIII—XVIII of Figure 15.

Figure 19 shows a portion of Figure 7 on an enlarged scale.

The invention is illustrated and described as based upon the well known "Astra" type of adding and subtracting machine, such as shown in Patent No. 1,987,932 issued February 14, 1933.

The adding and subtracting machine

Arranged on the keyboard 301 of the adding machine in well known manner are the nine keys 301', which are designated "1"–"9." The zero keys 302, 303 and 304 cooperate in well known manner with the setting piece carriage 305. "R" designates the repeat key through the setting of which the well known clearing mechanism acting on the carriage is disconnected. 306 designates the clearing lever for the setting mechanism. The key 307 having the minus sign (—) sets the machine for subtraction, that is, by pressing such key, the means for reversing the calculating or counting gears is actuated and the calculating mechanism operates subtractively. 308 designates the key by which the intermediate total is determined and 309 designates the total key. The operation controlled by keys 308 and 309 need not be described since it is fully shown in Patent No. 1,897,932 granted February 14, 1933 to J. E. W. Greve and in Patent No. 1,953,557 granted April 3, 1934 to J. E. W. Greve.

The setting piece carriage 305 is provided below and above with two rollers 420 by means of which it runs on two guide rails 421 attached to the machine frame. The carriage is provided with a plurality, in the present example ten, vertical rows of setting pins 333, each row comprising nine pins, so that the carriage of the present exemplary embodiment carries ninety such pins. The setting pins are set by means of the keys 301' or 302, 303 and 304.

Key 302 is attached to a key lever 359 which is journaled on a shaft 360 attached to the machine frame. The lever 359 is provided with a downwardly extending arm 361 with which a rod 362 is engaged. The right end of rod 362 is slidably guided longitudinally in a perpendicular bracket plate 422 attached to the machine frame. The end of rod 362 extends within range of the lowermost sliding setting pin 333, which corresponds to the "0" value. The keys 303 and 304 act in a similar manner on a similar rod. The operation of these keys is shown in Patent No. 1,707,303 granted to J. E. W. Greve, April 2, 1929.

The keys 301' are attached to the suitably formed nine key levers 423, which are also journaled on the shaft 360. Each key lever 423, except that which carries the "9" key, has a downwardly extending arm 424, each connected with a rod 425. The rods 425 are held so as to be longitudinally slidable at their free ends in the guide plate bracket 422.

The rod 425 which is connected with the key 301' designated "1," acts on the second row of sliding setting pins 333 which correspond to the value "1." The key 301' designated by "2" cooperates with the rod which is coordinated with the third row (from the bottom) of sliding setting pins 333, and so on. Keys 302 and 301' also cooperate with an escapement mechanism for the lateral movement of the carriage 305, which comprises the following construction.

The key levers which carry the corresponding keys 301' and 302 engage by their lower surfaces a rod 426, whose ends, as shown in Fig. 5 are attached to two levers 427. The levers 427 are attached to the shaft 360, which is rotatably journaled in the machine frame. One lever 427 is connected by a pin 428 to one end of a link 429 which at the other end, engages a lever 430. Lever 430 is attached to a shaft 431 rotatably journaled in a bearing 432 attached to the machine frame.

A plate 433 is also attached to shaft 431 and carries a shift tooth 433'. (See Fig. 5.) Another plate 434 is slidably mounted on plate 433. For this purpose, the two attaching screws 435 engage through corresponding slots 436 of plate 434. Plate 434 is provided with a shift tooth 437 corresponding to the shift tooth 433'. Also engaged with plate 434, at 438, is a traction spring 439 which is attached at 440 to plate 433. This spring tends to move plate 434 in the direction of the arrow in Fig. 5. According to Fig. 5, this plate is prevented from movement by its tooth 437 engaging in a rack 310 attached to the carriage.

If one of the keys 301' or 302 are depressed not only is the corresponding setting pin 333 of the vertical pin row in front of the rods 425 moved to the right from the position shown in Fig. 3, but also, at the same time, by means of the elements 426 to 430, the plate 433 is swung, against the traction of a spring 441, into the dotted line position of Fig. 3. In this swinging movement of the plate 433, the tooth 433' passes into the denture of rack 310, while tooth 437 is released therefrom and moves to the dotted line position of Fig. 5 through the traction of spring 439.

If the depressed key is released, then, through the traction of the spring 441, plate 433 again swings downwardly and the tooth 433' passes out of the range of the denture of rack 310 and the spring urged tooth 437 simultaneously passes into the denture of rack 310. Under the pull of the stronger traction spring 442 engaged with the carriage, the carriage is moved in the direction of the arrow in Fig. 5 for the distance of one rack tooth and the plate 434 again assumes the position shown in full lines in Fig. 5. The carriage has thereby been moved the distance between adjacent rows of pins 333 since each rack tooth corresponds thereto.

Associated with carriage 305 are a number of type carrying bars 330, of which, as shown in Figs. 2*a* and 5, eleven are provided arranged in adjacent relationship. It is to be noted that ten of these bars carry the types "0"–"9," while the eleventh contains the symbols or signs. The in-

dividual types 331 are arranged slidably on the bars 330. Provided at the lower end of each type bar 330 is a projecting shoulder 332 which extends within range of the setting pins 333 slidably mounted in carriage 305.

The type bars 330 are also each provided with an arm 334 over which a common cross bar 335 engages. The bar 335 is carried by a slide 336 which is moved upwardly by means of a link 337 connected thereto and by a control lever 338, connected to link 337 when the machine is operated. In this manner all the type bars 330 are released, so that they can pass upwardly under the pull of the traction springs 495 engaged with projections 494 thereon until the corresponding shoulders 332 contact the extruded setting pins 333 of the pin row coordinated therewith.

A rack 443 is associated with each type bar 330. Each rack 443 is provided with two pins 444 engaging in slots 445 of the bars 330. Each rack is provided with an arm 446 to which a traction spring 447 is engaged. The other end of spring 447 is attached to the bar 330 with which the rack 443 is associated. The spring 447 tends to move the rack 443 relative to the bar 330 in the direction of the arrow in Fig. 3.

The control of the bars 330 and consequently the actuator racks 443 is described in the above mentioned Patent No. 1,707,303. This control acts on the bars 330 so as to retain the bars 330 into whose range no vertical pin row in the carriage 305 has entered.

The calculating mechanism gears and reversing means therefor

Coordinated with the racks is a calculating mechanism consisting of a suitable number of counting gear wheels 448. The gears 448 are journaled on a shaft 449, which is attached in the two parallel plates 450 and 451. The two plates are pivoted to two levers 452 by pins 453, and the levers 452 are disposed at both sides of the set of bars 330. The levers 452 are interconnected at the bottom by a crossbar 454 and are mounted oscillatably on a trunnion 455 attached to the machine frame.

Each gear 448 of the calculating mechanism is engaged with a reversing gear 456. The gears 456, which have the same number of teeth as the gears 448, are journaled on a shaft spindle 457 which is attached to the two frame plates 450 and 451. Engaged with the lower end of the plate 450, at 458, is a link 459 which is connected by a pivot pin 460 to a lever arm 461. The lever arm 461 is fixed to the shaft 352 journaled in the machine frame 316. A plate 353, which is provided at both diametrically opposite ends with pins 354 and 355 is fixed to shaft 352. By setting or pivoting plate 353 into the dotted line position of Fig. 3, the plates 450 and 451 are swung about the pins 453 so that the calculating mechanism gears 448 unmesh from and the reversing gears 456 mesh with the racks 443. In this manner a certain predetermined movement of the racks in one direction with respect to the calculating mechanism gears 448 is reversed to the opposite direction and brings about the opposite method of calculation, that is, the value based on the magnitude of the rack movement is not added, but subtracted.

The tens transfer for the calculating mechanism 448, 456 is effected through the lever arm 602. The details of the tens transfer are described in Patent No. 1,897,932 granted to J. E. W. Greve, February 14, 1933.

The plate 353 is set in one or the other terminal position by means of a plate 356 which is provided with the two shoulders 357 and 358. Plate 356 is journaled at one end on a pin 462 provided on the end of a lever arm 463. The lever arm 463 is attached to a shaft 329 which is journaled in the machine frame 316. Also mounted on shaft 329 is a bellcrank lever 328 which is connected by a link 326 to a lever arm 324 attached to the main drive shaft 323. Through a means hereinafter described, the main shaft describes an oscillatory movement which is transmitted through the link 326 into a similar movement of the lever 463 connected to shaft 329.

A pin 464, attached to an arm 465, engages under the plate 356. Arm 465 is an extension of the key lever 466, which is journaled on shaft 360 and which carries the key 307 bearing the minus (—) sign. It is apparent that by pressing on the key 307, through the pin 464 the plate 356 is swung upwardly so that the shoulder 357 comes in front of the pin 354.

If the plate 353 was previously in the position shown by the full lines in Fig. 3, then, in the outward swinging of the lever 463, the plate 353 will be swung by the plate 356 into the dotted line position in Fig. 3 and the calculating mechanism gears 448 and 456 thus moved to the subtracting position.

The motor drive and coupling means

The keyboard 301 is also provided with the motor key 311 carried by the rod 312. The lower end of rod 312 is pivoted at 313 to a lever 314 which is fixed to shaft 315 journaled in the machine frame 316. Connected to shaft 315 is another lever arm 317 to which a rod 318 is connected. The arm 317 is under the action of a spring 317′ to return the motor key 311 after such key has been released. Rod 318 is connected by a pivot pin 467 to the lever 468 which actuates the clutch and contact devices. Lever 468 is journaled at 469 in the housing 319.

Attached to one end of the lever 468, with an interposed insulating member 470, is an electrical switch member 471 which cooperates with the two spring pressed contacts 472. The springs of the contacts are in the circuit of an electric motor 473, on the shaft 474 of which is attached a worm gear 475 which meshes with a worm gear 476. Worm gear 476 is attached to a vertical shaft 479 journaled in bearings 477 and 478 in the housing 319.

Attached to the shaft 479 is a ratchet tooth 480 with which the nose 482 of pawl 482 cooperates. Pawl 481 is mounted by means of the pivot pin 483 on a cam disc 484 which is freely rotatable on the shaft 479. A pressure spring 485, supported on a projection 486 on the cam disc 484 acts on the pawl 481. Cooperating with the free end of the pawl 481 is the hook end 487 of the lever 468, so that when the lever 468 assumes the position of Fig. 2a the hook end 487 holds the nose 482 of the pawl 481 out of engagement with the ratchet tooth 480.

Cooperating with the cam disc 484 is a cam roller 488 mounted on one arm of a double armed forked lever 489 pivoted on pin 490 provided in the housing 319. The other arm of lever 489 is pivotally connected by pin 491 to a link 492 which in turn is pivotally connected to rod 320 at one end thereof. The other end of rod 320 is pivotally connected by pin 321 to lever arm 322 fixed to main shaft 323.

Thus, if the motor key 311 is depressed, then,

by means of the levers 314 and 317, the rod 318 is moved to the left as shown in Figs. 1, 1a, 2 and 2a and the lever 468 is swung in the direction of the arrow in Fig. 2a whereby, through the switch member 471, the circuit for the electric motor 473 is closed and at the same time the hook end 487 releases the pawl 481, so that its nose 482 engages ratchet tooth 480.

In the ensuing rotation of shaft 479 by motor 473, the cam disc 484 is carried along and through the action of the double armed lever 489, the rod 320 is at first drawn to the right from the position shown in Figs. 1, 1a, 2 and 2a, thereby rotating the main shaft 323 counter-clockwise. The spring 493 connected at one end to the frame and at the other end to rod 320 maintains roller 488 in contact with cam disc 484 and returns the rod 320 to its initial position thereby rotating shaft 323 clockwise and returning the members connected therewith.

It is to be noted that during the swinging movement of the lever arm 322 in the direction of the arrow in Fig. 1, the slide 336 is moved upwardly, so that the bars 330 are released and can pass upwardly due to the traction of the springs 495 engaging projections 494, until the projecting shoulders 332 strike against an extended sliding pin 333. The stop for the key 301', designated "9," is the plate 600 (Fig. 3). If such key is depressed the carriage 305 makes an advance without one of the pins 333 being moved out. The corresponding bar 330 can then ascend until its shoulder 332 strikes against plate 600. This operation is also described in Patent No. 1,707,303 above mentioned. In this upward movement of bars 330 the types 331 are carried into the range of the printing device, which consists substantially of the platen 339 over which the paper strip 341 coming from the roll 340 runs. The ribbon 496 is disposed in front of the platen 339.

The calculating gears control

It is to be noted primarily that during the upward movement of the bars 330 the calculating mechanism gears 448 and 456 must not operate. On the contrary, the calculating gears are to be swung into operative position on the return of the rods 330 to the initial position. For this purpose the control means shown particularly in Fig. 4 are provided.

Fixed on a lever arm 452 is a pin 497 which cooperates with a latch 498. The latch is journaled at 499 to a frame extension arm 500 and is subjected to the action of a traction spring 501 which always tends to hold latch 498 engaged with the pin 497. The free end of latch 498 is provided with a pin 502, with which a toggle impact lever 503 cooperates. The toggle lever is pivoted at 504 to the free end of swinging lever arm 505 attached to shaft 329. In the initial position of the machine, the lever arm 505 assumes the position indicated in Fig. 4 by the full lines, and the finger-like extension 506 of the lever 503 is applied, through the pull of the engaging traction spring 507, against the pin 502. However the spring 507 is so weak that it cannot overcome the action of spring 501.

Mounted on the lever 452, on which pin 497 is provided, and by means of a suitable extension, is another pin 508 over which the forked end provided on one arm of a double armed lever 509 engages. The lever 509 is journaled by means of the pin 510 on the machine frame 316. The free end of lever 509 is provided with a pin 511 which extends into the movement range of the toggle impact lever 503 carried by lever arm 505.

If, by actuating the motor key, the main shaft 323 is rotated counter-clockwise, then, at the same time, by means of the link 326, the shaft 329 is rotated counter-clockwise and the lever arm 505 is swung out in the direction of the arrow in Fig. 4. In this swinging movement, the lower shoulder of the toggle lever 503 strikes against the pin 502 and the latch 498 describes a swinging movement in the direction of the arrow in Fig. 4. Through this swinging movement, the pin 497 is released from the latch catch so that the levers 452 together with the calculating mechanism gears 448 and 456 can swing through the traction of spring 512 to the right as shown in Fig. 4, so that the gears of the calculating mechanism can move outside the range of the racks 443. After the lever 503 has passed over the pin 502, the latch 498 is again drawn into the operative position, wherein the end of latch 498 is applied on the pin 497. Thus, immediately after the beginning of the upward movement of the bars 330, the calculating mechanism gears are swung into the inoperative position.

When the lever arm 322 reaches its extreme right end position, the lever arm 505 assumes the dotted line position of Fig. 4, in which position the finger-like extension 506 is applied against the pin 511 of the double armed lever 509 which is in the dotted line position of Fig. 4 corresponding to the swung out position of the levers 452. At the beginning of the reverse or return rotation of the shaft 329, and therefore before the downward movement of the bars 330, the upper shoulder of the toggle impact lever 503 strikes against the pin 511 and the double armed lever 509 is swung back into the position shown in full lines in Fig. 4.

In this swinging movement of the lever 509, pin 508 moves the levers 452 back to the initial position shown in full lines in Fig. 4. As soon as this initial position is reached, the latch 498 can again, due to the action of spring 501, lock the pin 497. This means, however, that while the bars 330 have been carried downwardly towards the initial position, the calculating mechanism gears 448 and 456 are in the position shown in Fig. 4 and in Fig. 3. While the bars 330 are moved downwardly, the calculating mechanism gears are shifted positively or negatively, according to whether the plate 353 has thrown gears 456 into mesh with racks 443 or not.

The printing mechanism

The printing mechanism which enters into operation when lever arm 505 assumes the dotted line position of Fig. 4 operates in the following manner.

It is first to be noted that the pin-like intermediate members 343, shown in Fig. 1, are opposite the ribbon 496. The hammer levers 345, mounted oscillatably on the common shaft 346, cooperate with the pin-like intermediate members, which are guided axially slidable in the support 344 and are held by the springs 343' in the position shown in Fig. 1. The hammer levers 345 are subjected to the action of springs (not shown) which tend to swing them in the direction of the arrow shown in Fig. 1. The tensioning of the levers 345 is provided by the crossbar 347 which is attached to a lever 348. The latter is connected with a lever arm 349 in the slotted end 350 of which a pin 351 on one arm of the bell crank lever 328 engages. The hammer levers

are provided with the well known checks, stop or the like which, when the machine is actuated, and assuming that it is set for printing, are released, so that, under the pull of the springs engaged therewith the hammer levers contact the reinforced ends of the intermediate members 343 and move these so that they strike the type in front of them against the paper 341 with the ribbon 496 interposed.

The above well known arrangements, which serve for addition and subtraction, are coordinated with a multiplier setting mechanism, described hereinafter and by means of which shortened multiplication is possible.

The multiplier setting mechanism

The parts belonging directly to the multiplier setting mechanism are mounted on the base plate 103, which is attached by screws 363 and 364 to the machine frame 316 of the adding machine. The multiplier setting mechanism has ten multiplier setting keys 97 bearing the indicia "0"–"9" which are disposed at the right of the keyboard 301 of the adding machine.

Each of the keys 97 is mounted on a slide 98 (Figs. 7 and 11). The upper ends of the slides 98 are guided in slots 99 provided in a plate 100, while the lower ends are guided in corresponding slots of a plate 101. The latter is attached by cross members 102 to the upper plate 100.

The cross members 102 are fixed to the frame wall 103 by means of the screws 104. Encircling the lower end of the slides 98 are the springs 105 which urge the cross extensions 106 on the slides 98 against the lower side of the plate 100 and thus tend to hold the slides in the initial position.

The main shaft oscillation control

Disposed longitudinally slidable between the two rows of slides 98 is a rectangular tube 107 which is guided in suitable recesses 108 provided in the cross members 102. Attached to tube 107 is a bearing eye 109 which extends downwardly through a longitudinal slot provided in the plate 101. Journaled in the eye 109 by means of the pivot pin 110 is a pawl 111 with which a spring 112 engages and which tends to force the pawl upwardly. In the initial position shown in Fig. 7 the nose 113 of the pawl 111 is applied against the end 114 of the slot 115 provided in the plate 101. A traction spring 117 engages at one end the pin 116 provided on tube 107 and at the other end is attached to the front cross member 102. This spring urges tube 107 to the left as shown in Fig. 7. In the initial position shown in Fig. 7 the tube is locked by the pawl nose 113.

Tube 107 is provided on both sides with window-like recesses 118 (see Fig. 17) which connect with recesses 119 provided on the upper side of the tube. When the tube 107 is in the initial position, these recesses 119 are positioned exactly under the cross extensions 106 of the slides 98. It is to be noted that the recesses 119 are substantially only as wide as the thickness of the slides 98. Also, the window-like recesses 118 are so arranged with relation to the recesses 119 that, when the cross extensions 106 of the slides have entered the recesses 118 due to pressure on the keys, and the pawl 111 is released, the tube 107 may move for graduated lengths corresponding to the particular number value. Thus, the recess 118 coordinated with the "0" key permits movement of the tube for the distance x, the recess coordinated with the "1" key for the distance $2x$, and the recess coordinated with the "4" key permits a movement of the distance $5x$, etc. It is the same with the keys "5"–"9", but therein the movement corresponds to the complementary value. The recess coordinated with the "5" key thus permits a movement of the distance $5x$ and the recess coordinated with the "9" key permits a movement of the distance x.

A rack 119′ is attached to the square tube 107 and engages gear 120. Gear 120 is mounted on pivot 120′ on the base plate 103 and is connected to a ratchet shifting wheel 121. A one tooth shift or rotation of the wheel 121 will cause a movement of the rack 119′ and consequently of the tube 107 for a distance x.

Associated with the lower ends of slides 98 are the two bars 122 and 123 which are carried link-parallelogram-like by the four members 125 journaled by pivots 124 to the bottom of the plate 101. Angular bars 127 and 128 (see Figs. 7 and 9) are pivoted at 126 to the ends of the bars 122 and 123. The bar 127 is provided with a slot 129 in which a pin 131 provided on a lever 130 engages. Lever 130 is oscillatably journaled on a pin 132 attached to the frame wall 103. The other bar 128 (see Fig. 11) is provided with a slot 133 into which a pin 134 extends. Pin 134 is attached to the lever 135 which is likewise journaled on pin 132.

Extending into the path of movement of bars 122 and 123 (see Fig. 9) is a pin 141 which is attached to a lever 142 pivoted at its front end to the frame 103 at 143. A traction spring 144 (see Figs. 7 and 8) is engaged at 142′ with the lever 142, and the spring 144 tends to hold the lever 142 in the position shown in Fig. 7. Journaled on the lever 142, at 145, is a pawl 146 having a projecting shoulder 147 which engages a shoulder 148 provided on the pawl 111. A spring 150 engages the pin 149 on the pawl 146 and tends to apply the pin 151 on the pawl 146 against the upper edge of the lever 142.

Cooperating with ratchet shifting wheel 121 is a plate 152 which is journaled oscillatably by pin 153 on the base plate 103.

Plate 152 has an arm acting as a pawl 154 which is retained in the initial position shown in Figs. 1 and 7 by the locking extension 155, which extends into a recess provided in the pawl 154 of the plate 152. The locking extension is provided on the end of one arm of a double armed lever 157 which is oscillatably journaled by the pin 158 in the wall 103.

Journaled at the free end of the other arm of lever 157 by the pin 159, is a second lever 160 with which is engaged one end of a torsion spring 161 which, at the other end, is supported by a pin 387. Engaged with the lever 157, as shown, is the traction spring 163, which tends to hold the locking extension 155 in engagement with pawl 154. By means of the torsion spring 161, lever 160 is given a tendency to swing counter-clockwise about pin 159. A lateral projection 164 provided at one end of the lever 160 is applied, in this manner, against the corresponding projecting pivot pin 110.

Plate 152 is subjected to the action of a traction spring 165 which tends to turn the plate clockwise. The spring 165 is connected to an arm 166 of the plate 152, and the arm 166 has a pin 167 connected to a bar 168 (Figs. 1 and 8). For this purpose the pin 167 engages through a slot 169 of the plate 103. Bar 168 is provided with a longitudinal slot 170 into which extends a pin 171 attached to the wall 103 (Fig. 8). The left end 370 of the bar 168 extends within range of a

pin 371 (Fig. 1) which is on a lever plate 372. The latter is journalled by a pin 373 to the frame of the adding machine and provided with an extended finger 374 which engages over a pin 375 provided on the rod 312 of the motor key 311.

The pin 387 serving as a support for the spring 161 extends into the plane of movement of the angularly bent end of the lever 160. The pin 387 is attached to the end of a double armed lever 388 (Fig. 1) which is journaled by pin 389 on the frame plate 103. Lever 388 has a cam-like end 390 extending into the range of movement of a lever 207.

Pivoted to the frame plate 103, at pivot 391, (Fig. 6) is a V-shaped plate 392 to which, at 393, there is secured a traction spring 394 which tends to swing the plate in the direction of the arrow in Fig. 6. One end 395 of the plate 392 extends within range of a pin 396 provided on a pawl 214. The other free end 397 of the plate 392 extends into the range of movement of a pin 398 which is attached to one end of the bellcrank lever 399, which is carried by the main shaft 323 of the adding machine and in every oscillation swings from the initial position shown in Fig. 6 in the direction of the arrow and back.

The step by step actuation of ratchet wheel

Attached to shaft 323 is also a lever 400 at the free end of which, at pivot 401, there is secured a connecting rod 402 which is pivoted at the other end on the pin 403. Pin 403 is attached to a lever 405 which is oscillatably journaled by pin 406 on the plate 103. Provided also at the end of lever 405 is a pin 407 which engages through a corresponding slot of the supporting plate and extends within range of an arm 177 provided on a slide 174. The latter is longitudinally slidable on plate 103 and for this purpose is provided with longitudinal slots 175 through which the screws 176 attached to the wall 103 project. Journaled on the bar 174 by pin 179 is a lever-like plate 180, at one end of which, at 181, there engages a traction spring 182 and the other end of the spring is attached, at 183, to the bar 174. The lever-like plate 180 is provided with a rectangular bent extension 184 which extends through a recess 185 provided in plate 103 within range of ratchet shifting wheel 121 (see Figs. 6 and 13).

Plate 174 is provided with a downwardly extending projection 186 (see Figs. 6 and 13) cooperating with the projection 187 of a sliding plate 188. The sliding plate is longitudinally guided by means of two slots 189 provided therein through which extend two pins 190 attached to the plate 103. The traction spring 191 engaged with plate 188 tends to move the plate to the right as shown in Fig. 6. Provided on the plate 188 is a pin 192 which extends into the plane of an abutting surface 193 provided on lever 160.

Pivoted to bar 168 by pin 215 is the pawl 214, with which the torsion spring 216 engages and which tends to apply the angular projection 217 of pawl 214 against the upper edge of the bar 168. (Figs. 6 and 8).

The carriage shift control

Coordinated with bar 168 is a sliding plate 365 which is provided with longitudinal slots 367 and 368. Engaging through the slot 367 is the screw pin 366 attached to the plate 103. Engaging through the other slot 368 is the pin 206, which is attached to a lever 207 and the lever 207 is journaled on a pin 208 attached to plate 103. The sliding plate 365 is provided with a shoulder-like projection 369 which cooperates with the correspondingly formed projection 395 of the pawl 214.

Means for aligning and disaligning recesses

Considering the case in which, through shortened multiplication in the immediately preceding decimal position, the next decimal position is greater by the value "1" than the value of the number, two U-shaped bars 227 and 228 are longitudinally slidably positioned (see Fig. 17) in the tube 107. These bars have recesses 229 corresponding to the recesses 118 in tube 107. Attached to each bar is a pin 230 (Fig. 7) which extends through a slot 231 provided in each side wall of the tube 107. Engaged with each pin is a traction spring 232, fastened at the other end, at 233, to the tube 107. The springs 232 thus tend to move the U-shaped bars 227 and 228 relative to the tube 107, in such direction that the pins 230 are applied against the right ends of the slots 231. In this position of the bars 227 and 228 relative to the tube 107, the operative edges of the recesses 118 are in operative relation to the window-like recesses 229 of the bars 227 and 228. These latter, however, as explained hereinafter, can, also, alternatively assume another position in which the corresponding edges of the window-like recesses 229 project forwardly of the edges of the window-like recesses 118, for a certain distance. This distance corresponds to the precedingly mentioned distance x, which at the same time represents a one step movement of the ratchet shifting wheel 121.

This alternative position is produced by a double armed lever 234 journaled on bar 227 by means of the screw pin 235 while the lever 237 is likewise rotatably attached by a screw pin 235 to the bar 228. The levers 234 and 237 are provided with hook-shaped projections 238 which alternately engage with corresponding recesses 239 provided on the tube 107. In the initial position according to Figs. 1 and 7 the hook-shaped projection 238 of the lever 234 lies in the coordinated recess 239, while the lever 237 is swung out so that its hook-shaped projection 238 is raised out of the range of its cooperating recess 239.

The bars 227 and 228 are returned from the position shown in Fig. 12 to that shown in Fig. 7 by striking an abutment 289′ carried by the bracket 289 secured to a plate 245 by the screw 302. See Fig. 19. Therefore, when the tube 107 assumes its initial position shown in Figs. 1 or 7, the abutment 289′ moves the bars 227 and 228 to their initial position.

Torsion springs 235′ (see Fig. 19) urge the projections 238 of the levers 234 and 237 into the corresponding recesses 239 of the tube 107 provided their own weight is not sufficient to do so.

Setting control

The levers 234 and 237 are provided with extensions 240 which extend obliquely downwardly and into the range of the pin-like abutments 241 and 242. The abutment 241 is attached to the angular extension of a bar 243, while the abutment 242 is attached to the angular extension of a bar 244 (see Fig. 9). Bars 243 and 244 are vertically slidable on a plate 245 attached at right angles to the plate 103. For this purpose, screws 246 attached to bars 243 and 244 engage through slots 247 provided in plate 245. See Fig. 16. Journaled between the two bars 243 and 244, at pivot 249, is a double armed lever 248 having the pins 250 which engage the bars 243 and 244.

The pins 250 project through the elongated recesses 251 provided in the plate 245. By means of this lever 248 the two bars 243 and 244 are positively interconnected so that when the one is moved downwardly the other is moved upwardly correspondingly. Lever 248 is held at both end positions. For this purpose, the pointed end 252 of the lever 248 cooperates with the gable-shaped extension 253 provided on a lever 254. The lever 254 is journaled by pin 255 on the plate 245 and is subjected to the traction of a spring 256.

Each bar 243 and 244 is provided with a recess 257. Extending into the recess 257 of the bar 243 is one arm 258 of a bellcrank lever having another arm 259. The bellcrank lever 258, 259 is connected with the lever 130 (Fig. 11). Engaging in the recess 257 of the bar 244 is an arm 260 of a similar bellcrank lever having another arm 261 and the bellcrank lever is connected to the lever 135.

As the lower ends of the key slides 98 extend into the range of the bars 122 and 123, on pressing a key 97 the lower end of the corresponding key slide contacts with the bar 122 or 123 and carries it into the position shown in Fig. 10 or Fig. 11. This causes the lever 142 to be swung downwardly and through the action of the pawls 146 and 111 releases the lock of the tube 107 and such tube can snap into a position determined by the particular cross extension 106.

Means for securing one decimal advance

Since, in certain cases, on pressing the key "0" and the key "9" (such as when on pressing the "0" key, when shortened multiplication was not used in computing the preceding decimal position, and on pressing the "9" key when shortened multiplication was used relative to the preceding decimal position) an advance is to be made for one decimal position, the following arrangement is provided.

The bars 122 and 123 (see also Figs. 15 and 18) are provided, in the range of the slides carrying the "0" and "9" keys, with bent portions 262, so that the key slides can pass by the bars 122 and 123 freely. Disposed in the range of these two key slides for the keys "0" and "9" are the double armed levers 263 and 264 (see also Fig. 14).

These two levers are journaled by means of pins 265 on a plate 266 which is journaled by means of a pin 267 on a sliding plate 268. The two end positions of the plate 266 are determined by a pin 269 mounted on the sliding plate 268 and this pin 269 extends into a rectangular recess 270 of the plate 266.

The sliding plate 268 is vertically slidable on a plate 272 attached by screws 271 to the plate 101 (see also Figs. 7, 13). For this purpose, the screws 273 attached to sliding plate 268 extend through corresponding slot-like recesses 274 provided in plate 272. Extending also through the lower guide slot 274 is the pin 275 attached to the slide 268, with which pin 275 there is engaged a traction spring 276 which is attached at the other end to the pin 277 provided on the plate 272. As shown in Figs. 7 and 14, the extension 279 on the lever 278 engages under the sliding plate 268. The lever 278 is connected with the above-mentioned lever arm 207 journaled on pivot 208.

Connecting the free lower ends of the levers 263 and 264 is the common traction spring 307 which tends to apply the pins 280 attached to said levers against the lower edge of plate 266 (see Fig. 15). The upper ends of levers 263 and 264 are provided with shoulders 281 which extend alternately within the range of the key slides coordinated therewith. In the position shown in Fig. 14, which corresponds to the initial position according to Figs. 1 and 7, the shoulder 281 of the lever 263 is in the range of the key slide 98 carrying the "0" key.

Plate 266 is provided on both sides, in the manner shown in Figs. 14 and 15, with projecting inclined surfaces 303. When the plate 266 is in the position shown in Fig. 14 and the bar 122 is moved downwardly then such bar moves freely over the corresponding edge 303. On the other hand, if bar 123 is moved downwardly, it comes into engagement with the oppositely projecting surface 303 and oscillates the plate 266 into the position shown in Fig. 15. It is to be noted, in this regard, that the plate 266 is frictionally mounted on the sliding plate 268 in such manner that the plate 266 remains in the position to which it is brought by the bar 123.

When the plate 266 is in the position shown in Fig. 15 and upon a further operation, the bar 123 is moved downwardly, such bar moves freely over the juxtaposed surface 303. On the other hand if, in this position of the plate 266, the bar 122 is moved downwardly, the plate 266 is swung back into the position shown in Fig. 14. It is clear from this, that the position, at any time, of plate 266 depends upon which of the two bars 122 or 123 was last moved downwardly. However, it depends upon the particular position of plate 266 whether the shoulder 281 of lever 263 is moved within range of the stem carrying the "0" key or whether the shoulder 281 of lever 264 lies within range of the "9" key stem.

Therefore, if the bar 122 was last depressed, the members 266, 263, 264 will assume the position shown in Fig. 14, and if the bar 123 was last depressed, they will assume the position shown in Fig. 15. When the said parts are in the position shown in Fig. 14, then, if the "9" key is depressed, the sliding plate 268 is not moved. On the other hand, if the said parts (266, 263, 264) were in the position shown in Fig. 15, the plate 268 would be moved and when the "0" key is pressed, the plate 268 is not moved downwardly.

Provided on each of the bars 122 and 123 is a downwardly extending arm 291 (see Figs. 7 and 10) to which a double armed lever 293 is pivoted by means of the pin 292. These levers 293 are provided at their upper ends with tongue-like extensions 294 and the bent portions 262 of bars 122 and 123 are slotted in the range of such extensions (see Figs. 10 and 11). Engaged with each lever 293 is a traction spring 295 attached at the other end, at 296, to the bar 122 or 123 and which tends to draw the tongue-like extension out of the range of the coordinated key slide and apply the upper end of the lever 293 against an abutting pin 297 provided on each bar.

The lower free end of each lever 293 is provided with a pin 298. These pins 298 extend into slots 299 provided at the ends of the two bars 300. These two bars are connected at their other ends by pins 301 with the arms 259 or 261 of the bellcrank levers cooperating with recesses 257. By means of these bars 300 and the members 257 to 261, 243, 244 and 248, the levers 293 are so interconnected that only the tongue-like extension 294 of one lever 293 will always extend into the range of its cooperating key slide. In the initial position of Fig. 1 the tongue-like extension 294 coordinated with the key "0" would thus be carried out of range of the corresponding key slide, while the other tongue-like extension 294 extends in

the range of the corresponding key slide of the key "9".

Pivoted on the pin 206 of lever arm 207 is a control bar 376 (Fig. 1) which, at the other end, is connected by a pin 377 with a lever arm 378. The latter is mounted freely rotatable on a shaft 380 journaled in a frame extension 379. Attached to the shaft 380 is a plate 381 which is engaged by a traction spring 382 attached at the other end, to pin 383, on the lever 378. This traction spring tends to apply the shoulder 384 of the plate 381 against the pin 383. A lever arm 385 is also attached on the shaft 380 and has a pin 386 extending into the plane of the extension 361 provided on the key lever 359.

Control of reversing mechanism

The reversing or shifting of the calculating mechanism, that is, its positive or negative, or additive or subtractive, connection with the rods 330, is initiated by the two slides 243 and 244 arranged on the wall 245 connected to the plate 103. These slides are controlled by the bellcrank arms 258 and 260. For this purpose, there is coordinated with the slides 243 and 244, a setting plate 408 (Fig. 16) which is pivoted by means of the pin 409 to the double armed lever 410. Lever 410 is journaled on the pivot pin 411 secured to plate 412 which is connected to plate 103.

The setting plate 408 is provided with two slot-like recesses 413 and 414 which open into two V-shaped openings. The pins 250 on the slides 243 and 244 are so constructed that they project with their ends into the range of movement of plate 408. If the plate 408 is in the position shown in Fig. 16, the coordinated pin 250 has passed into the recess 413. Inasmuch as the rods 243 and 244 are still in the initial position, lever 410 is in the position shown in Fig. 16. The end of a lever 416 (see also Fig. 1*a*) journaled at 415 on the machine frame contacts the free end of lever 410. Attached to lever 416, by rivets or the like 417, is an arm 418 having a bent end 419 which engages under the setting plate 356.

If, now, the slides 243 and 244 are shifted from the initial position according to Fig. 16, which takes place for example when one of the keys "5"–"9" is depressed, the slide 243 is moved downwardly and the slide 244 upwardly, and at the same time lever 413 is swung by the plate 408 so that the lever 410 causes the lever 416 to swing out in the direction of the arrow in Fig. 1, that is, raises. The setting plate 356 is thereby raised to such extent that its shoulder 357 passes into the range of the pin 354.

If minus multiplications are desired it is only necessary, by means of the handle 420, to swing the plate 408 into the other end position, in which the pin 250 coordinated with the recess 414 is engaged. The handle 420 (Figs. 2 and 16) is mounted on a lever 421 journaled on pivot 422 on the frame bracket 289 and the forked end 423 of lever 421 engages the correspondingly reduced end 424 of the plate 408.

The operation

The operation is explained with reference to a calculating example:

$$12738 \times 26092$$

The multiplicand 12738 is first set up on the keyboard 301, beginning with the highest decade, thus the "1," then the "2," the "7," then the "3" and finally the "8," by depressing the corresponding keys 301′. Then, after the repeat key "R" has been actuated, beginning with the lowest digit, the multiplier is set up in the multiplier setting mechanism keys 97. The key designated "2" in the two key banks carried in plate 100 is next depressed.

By depressing key "2," the parts are carried into the position of Fig. 8 by contact of the slide 98 on the bar 122. Bar 122 contacts pin 141 and lever 142 is swung downwardly which, through the pawl 147, carries pawl 111 into the release position. The tube 107 is now moved by its spring 117 as far to the left as the cross extension 106 of the key slide associated with key "2" will permit. Since, in the initial position, the lever 234 is engaged with the notch 239 on tube 107, the U-shaped bar 227 is adjusted in tube 107 so that the edges of its window-like recesses 229 project beyond the corresponding edges of the window-like recesses 118.

Thus, as shown in Fig. 8, the corresponding cross extension 106 contacts with the edge of a window-like recess 229 of bar 227. The stroke or shifting space of tube 107 coordinated with key "2" is thus shortened one shift from three shift movements, so that the ratchet shifting wheel 121, as shown in Fig. 8, has been turned from the initial position in the direction of the arrow for two spaces or shift movements, corresponding to this adjustment.

Simultaneous with the downward movement of the bar 122 into the position shown in Fig. 8, bar 127 is carried downwardly due to its pivotal connection with bar 122. As the lever arm 130 is already positioned downwardly in the initial position, no movement takes place.

It is to be noted that in the initial position, the members 408, 409 and 410 are in the position shown by full lines in Fig. 16 and thus the setting plate 356 is in the position shown in Fig. 1*a*. At the same time however pin 110 has released the lateral extension 164 of lever 160 so that it engages by a shoulder 282 over the pin 141 of the downwardly swung lever 142. If the key "2" is thereupon released, so that its cross extension 106 may be applied against the upper limiting edge 283 of the window-like recess 118 on tube 107, then at the same time the bar 122, through the pull of a spring 284, will follow the slide 98 since the bar 122 remains engaged with the lower end of the slide. On the return of the bar 122 it releases the pin 141, so that lever 142 can likewise follow under the pull of the spring 144. The pin 141 then carries the lever 160 somewhat upwardly, so that the lever 157 on which the lever 160 is mounted, is swung into the dotted position shown in Fig. 8. The lever 157 then releases the plate 152, so that it swings the pawl 154 against the ratchet wheel 121, in the position shown in Fig. 8 in dotted lines.

During the swinging movement of the plate 152, the bar 168 is at the same time carried by means of pin 167 to the left in Fig. 8, into the dotted position. In this movement of the bar 168, its end 370 contacts the pin 371 of the plate 372 and swings it into the position shown in Fig. 8. In this movement, finger 374 of the plate 372 has moved the rod 312 of the motor key 311 downwardly. Through the downward movement of rod 312, the circuit of motor 473 is closed by means of the members 314, 317, 318, 468 and 471. The coupling 480 and 482 is also connected so that the shaft 323 is oscillated by means of the elements 484, 489, 492, 320 and 322.

In the counter-clockwise oscillation, in the direction of the arrow in Fig. 1, the pin 325 is

swung upwardly, so that the type carrying bars **330** are released. These are then set up according to the values of the multiplicand 12738 contained in the carriage **305**.

The oscillation of shaft **323** causes a corresponding oscillation of shaft **329** and this causes a reciprocation of setting plate **356**. As this plate, as above stated, is in the lower position, as shown in Fig. 1, the plate **353** is not reversed or shifted in this movement. On the downward return movement of bars **330**, the calculating mechanism gears **448** and **456** are swung in as described above, so that the value contained in the carriage is transferred once to the calculating mechanism by such gears.

In the oscillation of the shaft **323**, the link **402** swings the lever **405** in the direction of the arrow in Fig. 6 causing the pin **403** on the lever **405** to strike the extension **177** of the sliding bar **174** and move it to the right from the position shown in Fig. 6, against the traction of the spring **286** (Fig. 13) engaged therewith. In this movement of the bar **174** the shifting extension **184** contacts the ratchet shifting wheel **121**, which in the present case is in the position shown in Fig. 8, and rotates it clockwise back for one step.

After the shaft **323** has returned to its initial position, after an oscillation, the multiplicand 12738 has been transferred once into the calculating mechanism. In the following second oscillation of the main shaft **323**, the bar **174** is once more moved to the right so that the shifting extension **184** causes a second clockwise step rotation of the shifting wheel **121**.

Inasmuch as the shifting wheel has moved previously counter-clockwise for two shift movements, thus at the end of the second oscillation of the shaft **323**, the pin **287** on the shifting wheel **121** comes into range of a projection **290** provided on plate **152** and this plate **152** is swung into the initial position shown in Fig. 7.

By the return of the plate **152** into the initial position, the bar **168** is moved to the right back to its initial position and the pin **371** on the lever **372** is released so that the lever **372** may move to the position shown in Figs. 1 and 6. This breaks the electric motor circuit and disconnects the calculating mechanism drive. During the second oscillation of the main shaft **323** the multiplicand is carried a second time into the calculating mechanism.

It is to be noted that in the return movement of the bar **168** to the right, as shown in Fig. 6, the pawl **214** which, in the movement to the left of the bar **168**, has passed in front of the shoulder **369**, carries the slide plate **365** along in the direction of the arrow in Fig. 8. In this movement of the slide plate **365**, the lever **207** connected therewith by the pin **206** is swung out in the direction of the arrow in Fig. 6. In this outward swinging of the lever **207**, the lever **378** is swung to the right by the rod **376** and the spring **382** is placed under tension. Through this movement of the lever **378**, the plate **331** is given the tendency to swing to the right (see Fig. 1). The lever **385** by means of pin **386** is applied against the extension **361** of the lever **359**, which is thereby swung downwardly. This causes, however, by means of the associated rod **362** a movement of the carriage **305** for one decimal position in the direction of the arrow in Fig. 2.

It is also to be mentioned that, while the shaft **323** is oscillated the pin **398** on the lever **399** releases the corresponding arm of bellcrank lever **392**, so that the bellcrank lever may swing under the pull of the spring **394**. When, at the end of the second oscillation of shaft **323**, the pin **398** contacts with the corresponding arm of bellcrank lever **392**, the latter is again swung into the position shown in Fig. 6. It then engages under the pin **396** of pawl **214**, which is thereby raised into the position shown in Fig. 6. This causes the shoulder **369** of the slide **365** engaged by the pawl **214** to be released and the slide **365** can now snap back to the initial position shown in Fig. 6.

Entry of second decimal position of multiplier

The second decimal position of the multiplier is now to be entered. The "9" key of the multiplier keys **97** is depressed. It is to be noted that the lever **293** coordinated with the "9" key (Fig. 11) is swung so that its tongue-like extension **294** extends into the range of the key slide **98**. If the key "9" (see Fig. 11) is depressed now it contacts with the tongue-like extension **294** of the corresponding lever **293**. The key slide can thus not pass through the bent portion **262** but contacts with the corresponding tongue **294** and the bar **123** is forced downwardly. By means of the downward movement of the bar **123**, the lever **135** is swung downwardly therewith by means of the bar **128**, which, through the setting members **257—261**, **243**, **233**, and **248**, results in the shifting as shown in Fig. 11, in which at the downward end position of key "9" the lever **293** assumes the position shown in Fig. 11, and the tongue **294** coordinated with the key "9" is drawn out of the slot in the bent portion **262**, while the tongue coordinated with the unpressed key "0" is swung into its cooperating slot.

In the downward movement of the bar **123**, the lever **142** has been swung by means of the pin **141** and the pawl **111** is released. Tube **107** can thus pass to the left (Fig. 11) until the edge of the window-like recess **118** is applied against the cross extension **106** of the key slide. When the "9" key is pressed, the pawl **237** is raised out of notch **239** and through the corresponding spring **232** the U-shaped bar **228** is adjusted so that its window-like recesses **229** are aligned with the window-like recesses **118** of tube **107**. The tube **107** may thus move to the left for one shift, as is apparent from the position of the shifting wheel **121** in Fig. 11. When the key is released, in the same manner as above described, the plate **152** will snap into the dotted line position of Fig. 8 and through the bar **168**, the circuit of the motor is established and the calculating mechanism connected. The calculating mechanism then describes an oscillating movement of the main shaft **323**, while the multiplicand 12738 is carried negatively, that is subtracted, in the second decimal position by the calculating mechanism gears **448** and **456**.

It is to be noted that in the shifting of the rods **258** and **260**, the lever **410** was moved into the dotted line position of Fig. 16, thus causing the setting plate **356** to be raised, so that its shoulder **357** is in front of the pin **354**. At the beginning of the oscillating movement of the shaft **323** the plate **353** was carried into the dotted line position of Fig. 3 so that in the next movement of the calculating mechanism the reversing gears **456** are engaged with the racks **443**.

During said oscillation of the main shaft **323**, the bar **174** is moved once in the direction indicated in Fig. 6 in the manner above described, and the shifting wheel **121** describes a backward clockwise shifting movement, and is thereby carried to the initial position shown in Fig. 7. The

plate 152 is again swung back by means of pin 287 and the bar 168 is simultaneously also drawn to the right to the pisition shown in Fig. 1, so that the motor 473 and the coupling 480 and 482 are disconnected through the member 372.

Simultaneously with the return movement of the bar 168 to the right another shift movement of the carriage 305 is brought about by means of the pawl 214 and the plate 365, as above described.

Entry of third decimal position of multiplier

The third decimal position of the multiplier is now to be entered. The "0" is carried into the multiplier mechanism by pressing the corresponding multiplier key 97. See Fig. 10. Since shortened multiplication was done in the second decimal position, the tongue 294 is in the range of the key slide 98 coordinated with the key "0." If the "0" key 97 is depressed the lower end of the key slide 98 first contacts with the tongue 294 and a descending movement of the bar 122 is initiated. On further descent to the end position in Fig. 10 the lower edge of slide 98 slides along the upper edge of the bar 122.

Since, before depressing the "0" key, the abutment 241 was in the lower position, the coordinated pawl 234 was raised from the notch 239 of the tube 107, so that on release of the tube it can pass into the position shown in Fig. 10, wherein the cross extension 106 on the key slide is applied against the corresponding edge of the recess 118. As a result of pawl 234 having been raised, the bar 227 is moved in tube 107 so that the edges of the recesses are aligned. Shifting wheel 121 can thus rotate for one step, as shown in Fig. 10.

Through the pressure on the "0" key, the bar 122 was carried downwardly and, by means of the bar 127, the lever 130 was shifted into the position of Fig. 10. This causes a shifting of the corresponding shift members 243 and 244 into the position according to Fig. 16. The lever 410 again passes into the position shown in Fig. 16 in full lines and the arm 418 has allowed the plate 356 to drop, so that its lower shoulder 358 is within range of the pin 355. During the following oscillation of shaft 323 the multiplicand 12738 is carried once, positively, into the calculating mechanism. During this oscillation (of the shaft 323), however, the shifting wheel, which previously was moved for one step from the initial position, is again returned to the initial position as shown in Fig. 7. Therefore the bar 168 is drawn back and the lever 372 released with a consequent breaking of the motor circuit and an uncoupling of the calculating mechanism. At the same time, however, by means of the pawl 214 and the plate 365, another shift step of the carriage 305 is brought about, so that the carriage is moved to the next higher decimal position.

Entry of fourth decimal position of multiplier

The fourth decimal position of the multiplier is now carried into the calculating machine by pressing the multiplier key 97 marked "6". On depressing the "6" key the lower end of the corresponding key slide 98 (Fig. 9) strikes against bar 123 and moves it downwardly. Tube 107 is thereby released in the manner previously described, so that it can pass to the left, until the coordinated cross extension 106 contacts with the corresponding edge of the window-like recess.

Since, on pressing the "0" key, the slides were shifted so that that designated 244 assumed the lower, and that designated 243, the upper position, the coordinated pawl 234, on depressing the "6" key, assumed the swung out position, so that its U-shaped bar 228 assumed the release position. The corresponding bar 228 could thus, through the traction of spring 232, be drawn back so that its window-like edges registered with the edges of the window-like recesses in tube 107. This means, however, as shown in Fig. 9, that the tube 107 can move to such an extent that the shifting wheel 121 may describe four shift steps to bring pin 287 into action.

It is also to be noted that, by pressing on the bar 123 and actuating the bar 128, the levers 135 and 130 are carried into the position of Fig. 9. This causes the lever 410 to be shifted into the dotted line position of Fig. 16 through the action of the setting members 243 and 244. The setting plate 356 is thus swung by the arm 418 into the upper position in which its shoulder 357 comes in front of the pin 354.

In the consequent four oscillations of the main shaft 323 (corresponding to the four shifts of the wheel 121) the multiplicand 12738 is subtracted four times at the corresponding decimal position by the calculating mechanism gears 448 and 456. During the fourth oscillation of the shaft 323 the shifting wheel reaches its initial position as shown in Fig. 7 and the shift bar 168 is again moved to the right into its initial position. This, in turn, results in the disconnection of the electric motor 473 and the clutch 480, 482. In the return of bar 168, the carriage 305 is shifted a step by means of the pawl 214 and the plate 365.

Entry of fifth decimal position of multiplier

If, now, the multiplier key 97 marked "2" is pressed for the fifth decimal position of the multiplier, the position shown in Fig. 12 is assumed. As the pawl 234 coordinated with bar 227 is in the raised position, tube 107, in contrast to the position according to Fig. 8, can move to the left for three shift steps. The main shaft will, therefore, describe three oscillations before the bar 168 is moved to the right and the lever 372 is swung to disconnect the motor 473 and the coupling 480, 482. As the bar 127 is carried downwardly on depressing the multiplier key 97 marked "2", the levers 130 and 135 are shifted so that the lever 410 again assumes the position shown in Fig. 16 in full lines. Arm 418 thus releases the setting plate 356, so that its shoulder 358 can come in front of pin 355. In the first rotary movement of main shaft 323 the calculating mechanism gears 448, 456 are carried into the plus or positive position, so that during the three oscillations of shaft 323 the multiplicand is carried three times into the corresponding next highest decimal position, positively.

The calculation is then terminated and the calculating mechanism contains the result

332, 359, 896

By actuating the keys 308 or 309 this result can be transferred to the type bars and printed on the strip 341.

The adding machine has thus done the following: first, the multiplicand 12738 was carried twice, positively, into the calculating mechanism. After a shift advance of the carriage 305 into the next higher decimal position the multiplicand was introduced once into the calculating mechanism subtractively. After a further shift movement of the carriage into the next higher decimal position the multiplicand was transferred positively into the calculating mechanism. This done,

the carriage made a further shift movement into the next higher decimal position, in which the multiplicand was then introduced four times into the calculating mechanism. Finally, after another shift movement of carriage **305** into the next higher decimal position the multiplicand was added three times in the calculating mechanism. The calculation was thereby terminated and it was completed with eleven oscillations of the main shaft **323**.

In the calculating example here involved the multiplier figure last keyed is a "2". For this the machine operates normally, that is, not with short cut multiplication. In order to prevent incorrect calculation when the highest multiplier figure is above 4, it is necessary then to depress the multiplier key designated "0". In order to avoid error, it is preferable for the operator, always at the termination of the calculation, that is, after he has fully keyed the multiplier, to depress the zero multiplier key.

It is to be understood that the invention above described is not limited to "Astra" machines and may be embodied in other makes of adding machines and is capable of various modifications.

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ADDING MACHINE
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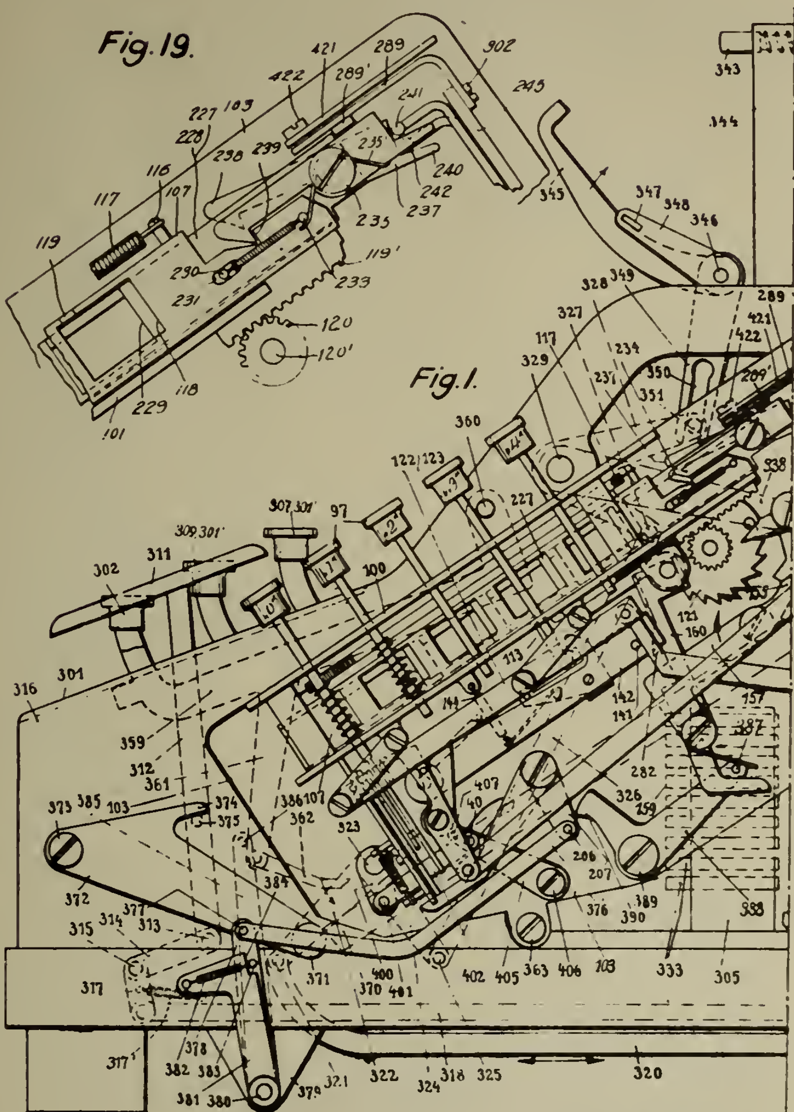
12 Sheets-Sheet 1



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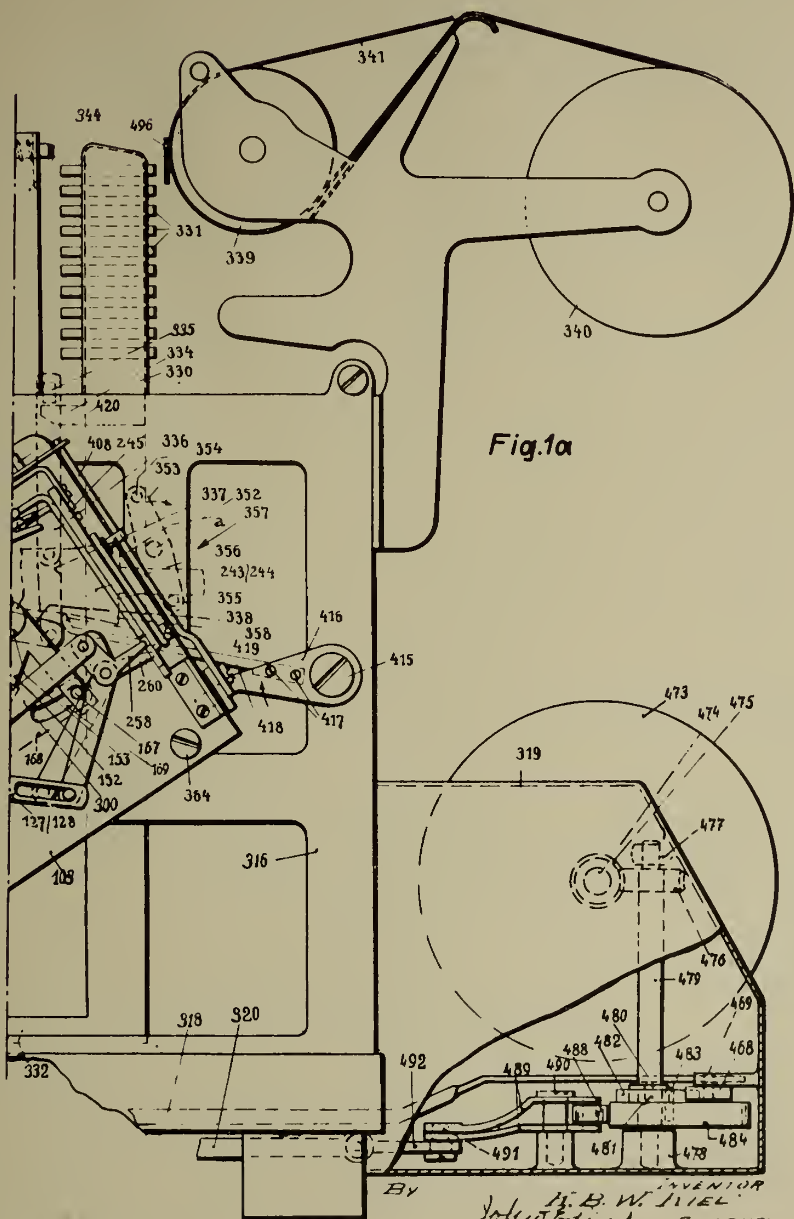

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Fig. 2

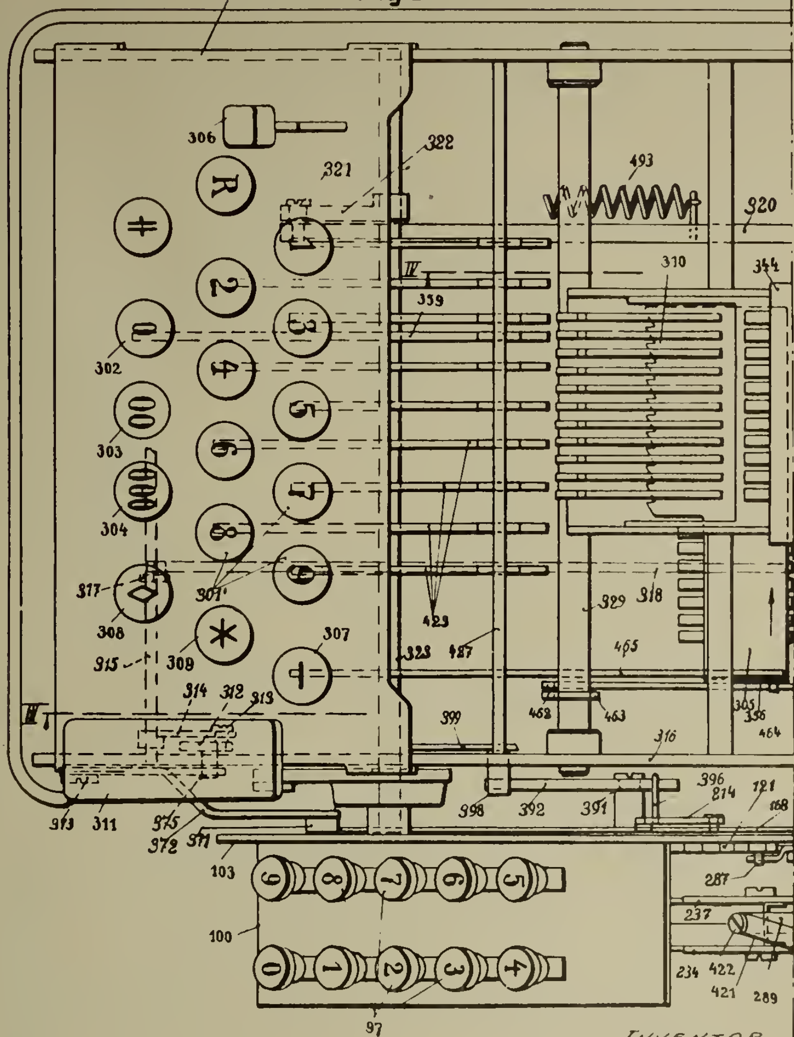

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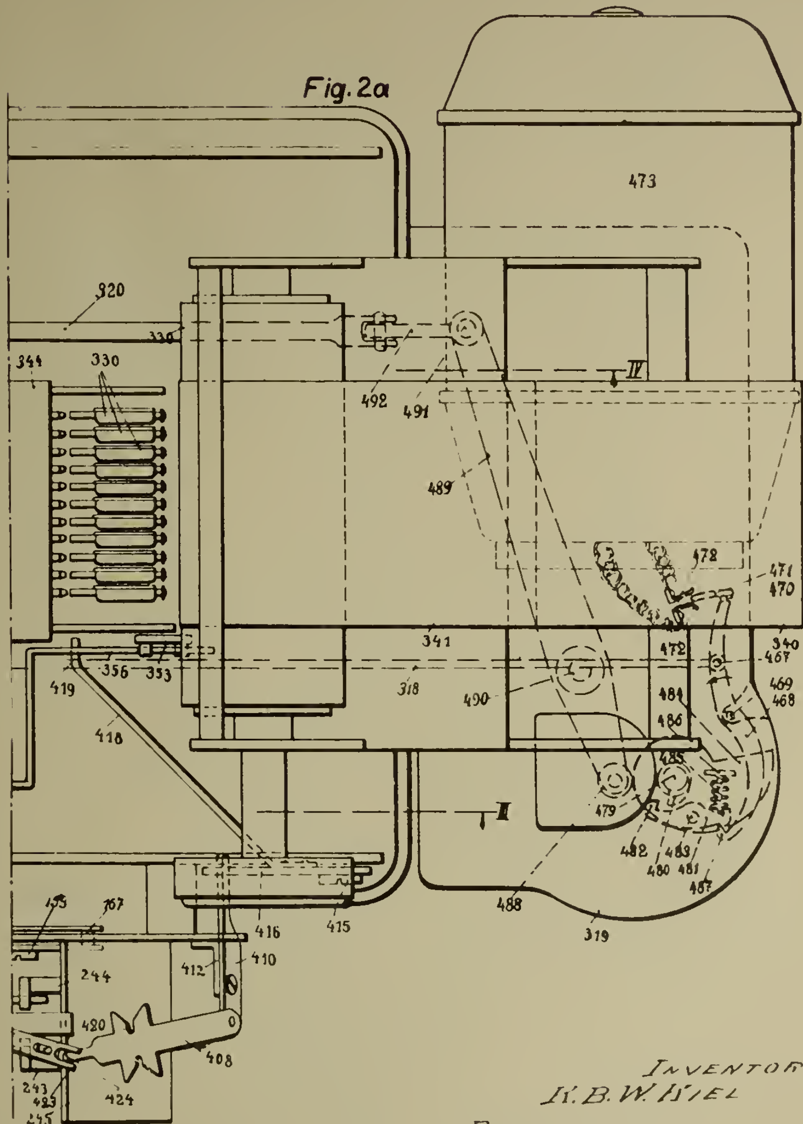
Fig. 2a



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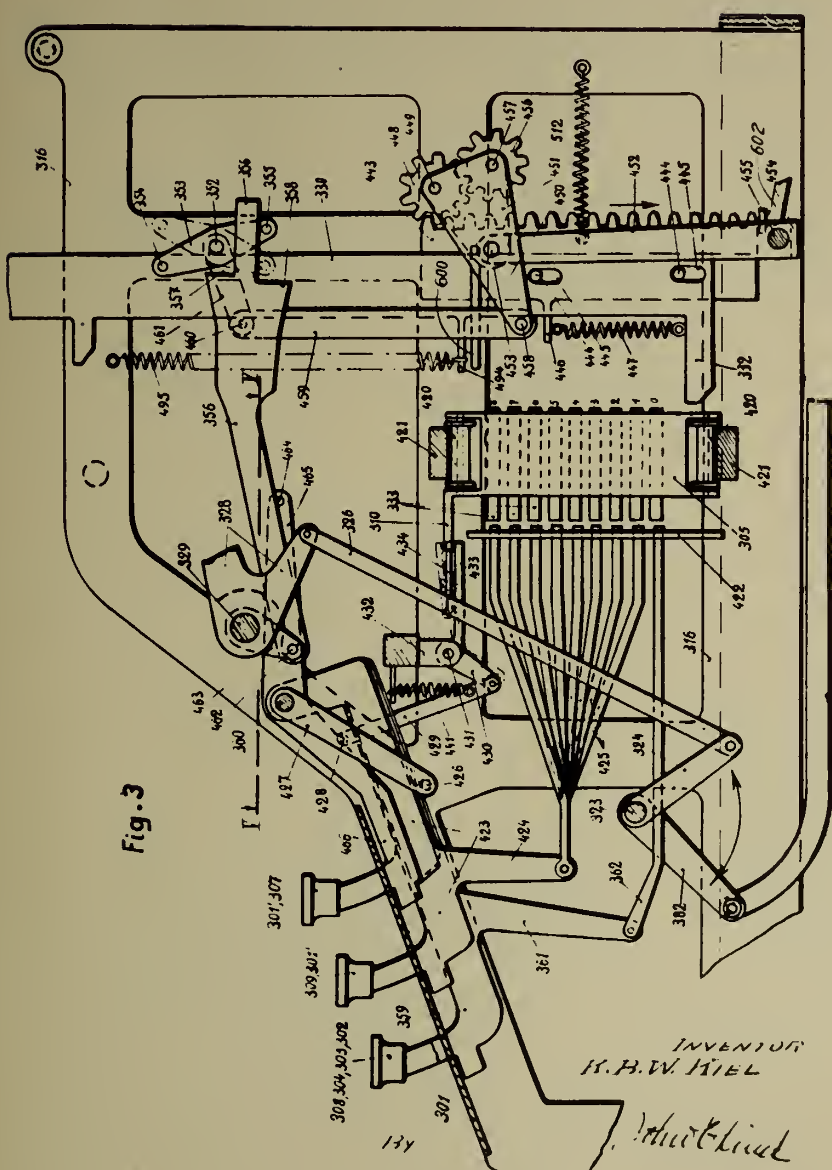

Fig. 3

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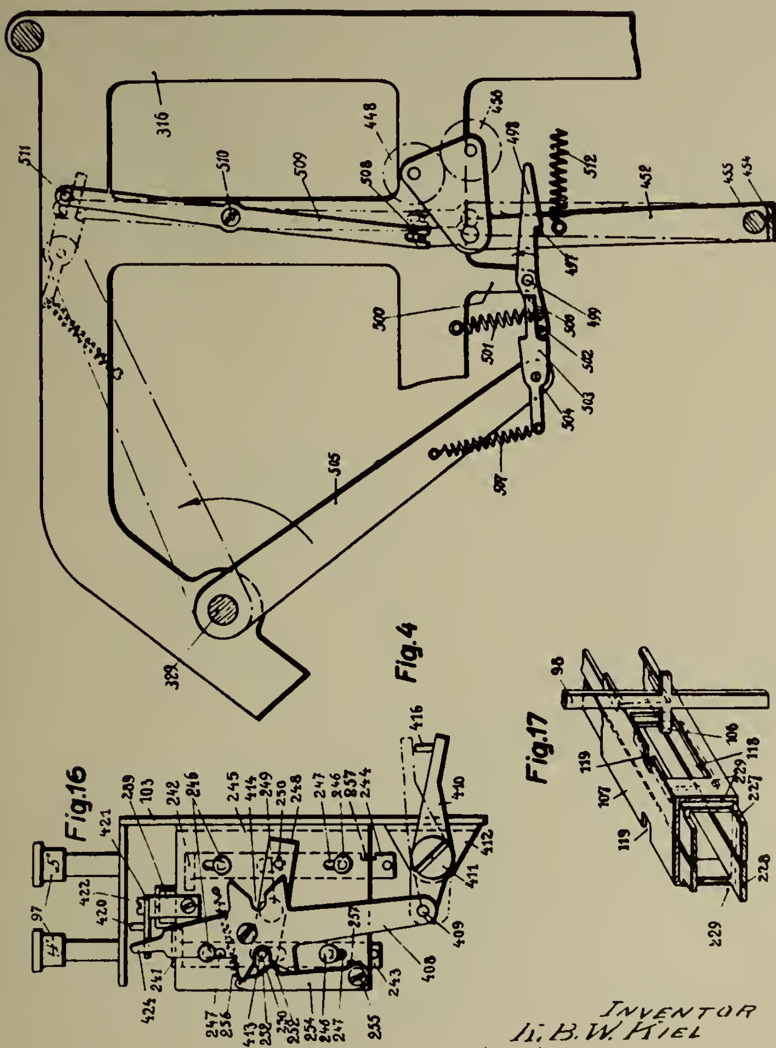

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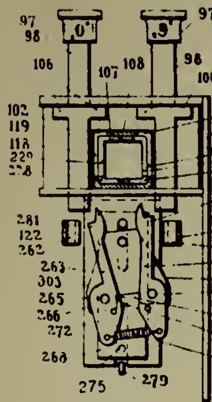

Fig.14

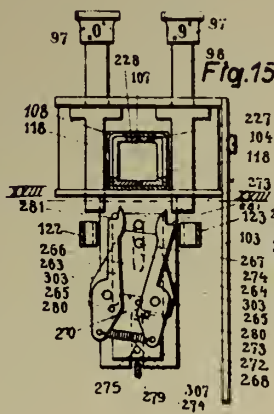

Fig.15

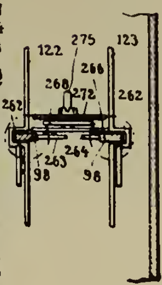

Fig.18

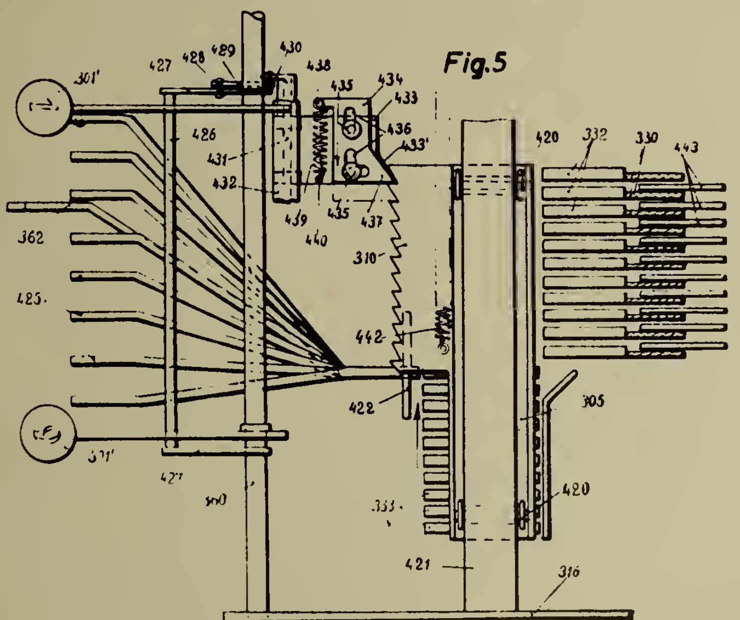

Fig.5

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Fig.13

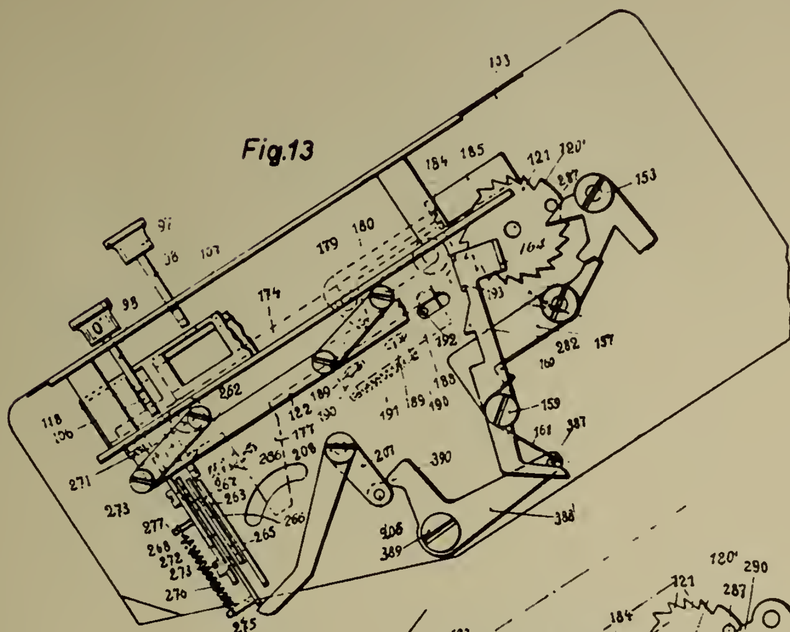

Fig.6

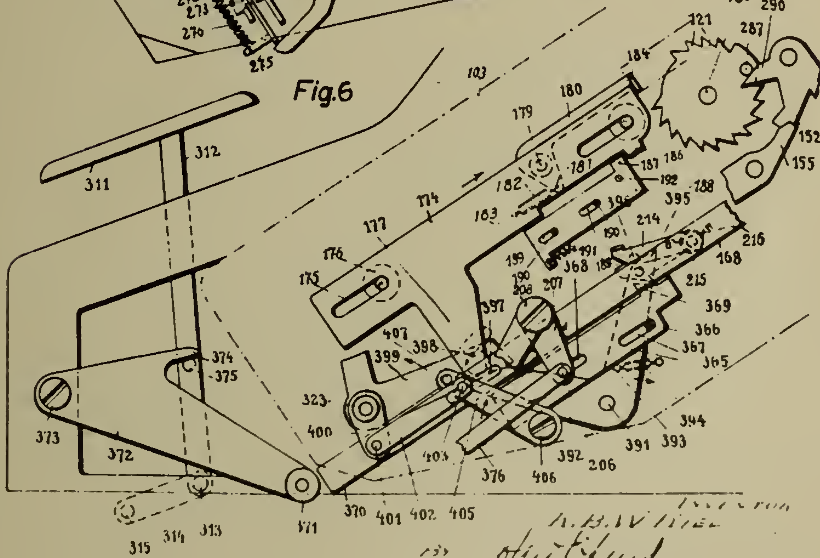

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Fig.7

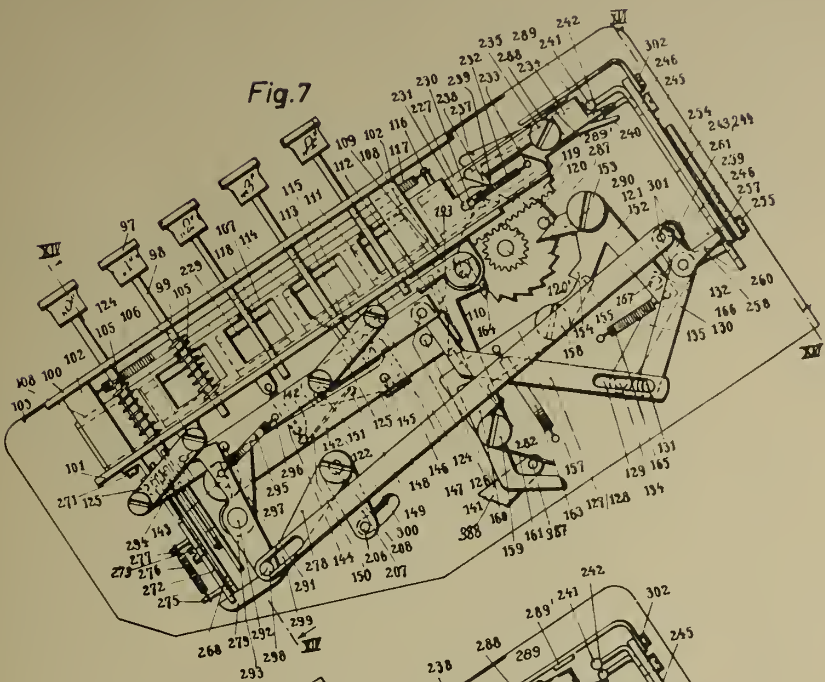
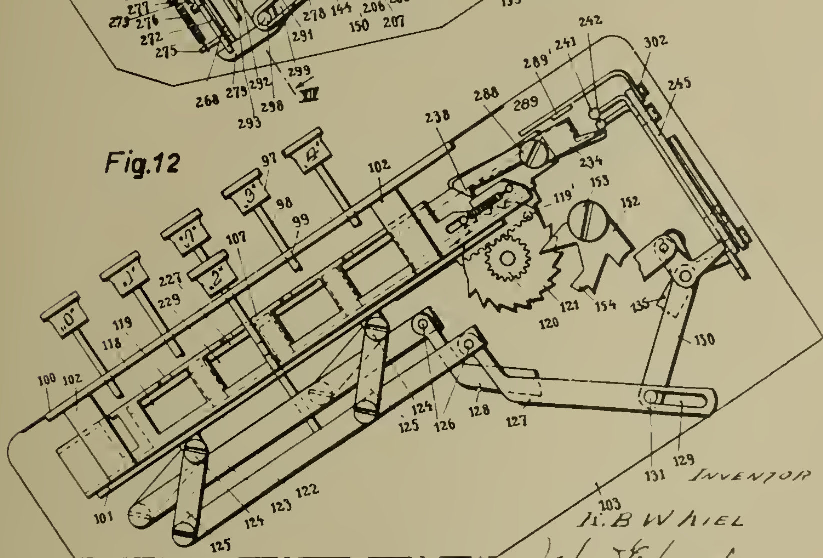


Fig.12



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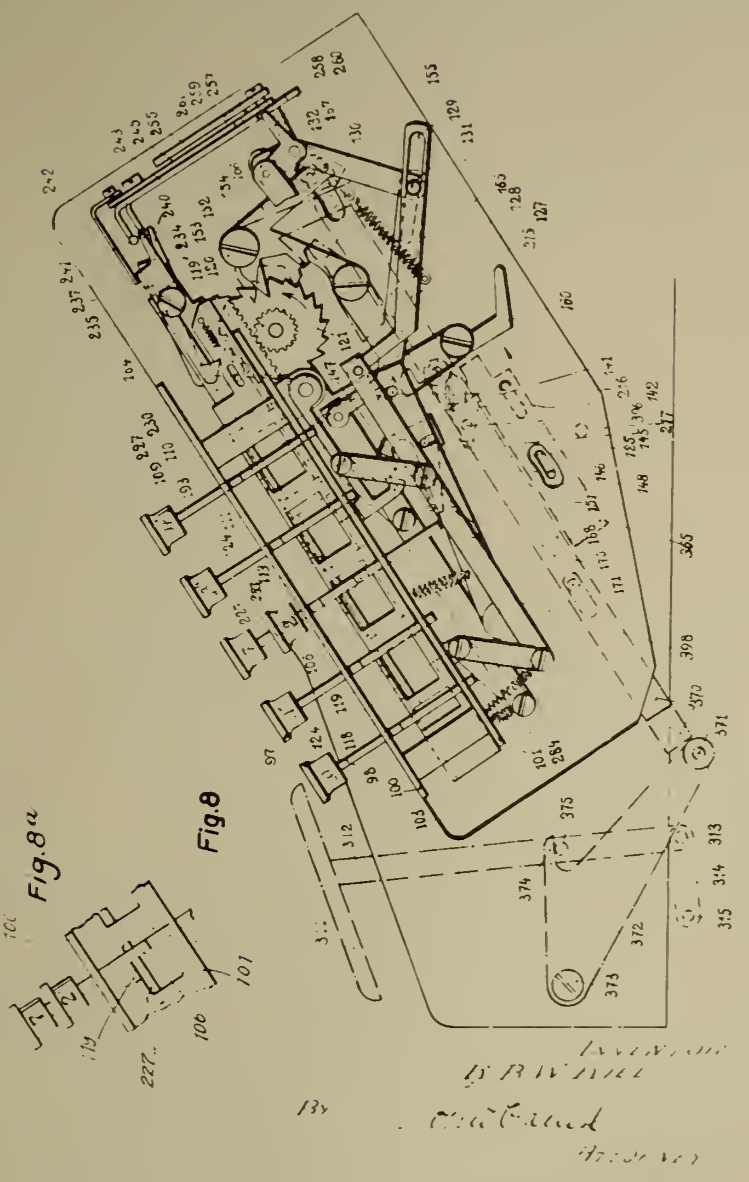

Fig.8a

Fig.8

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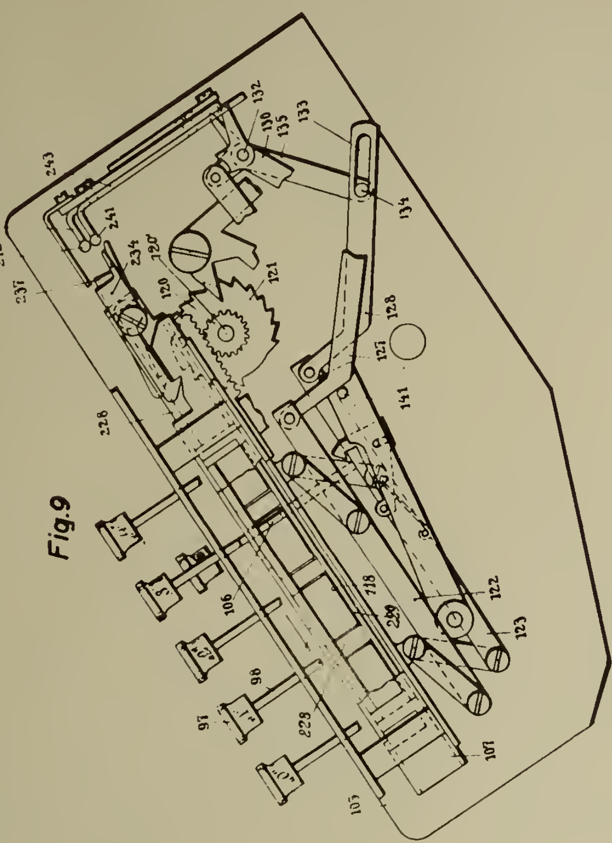

Fig.9

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Fig.10

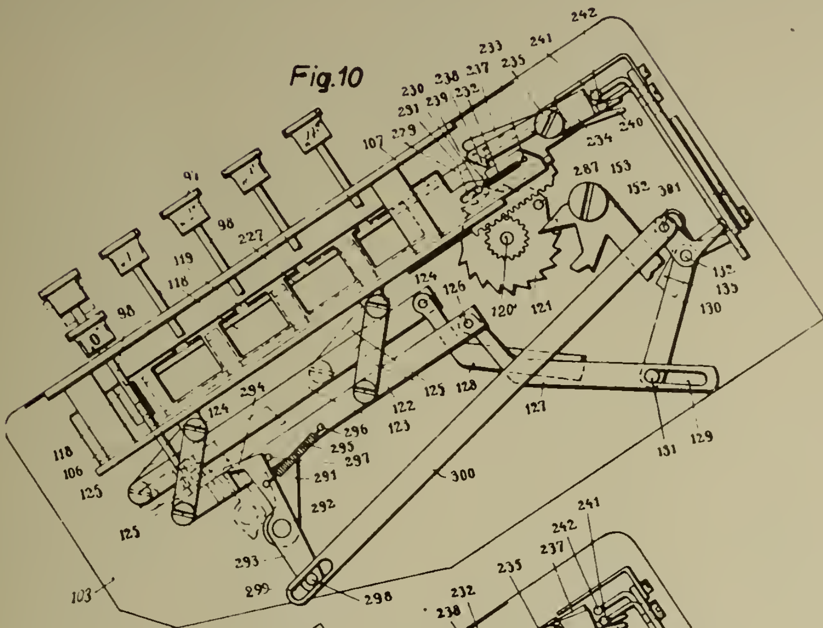
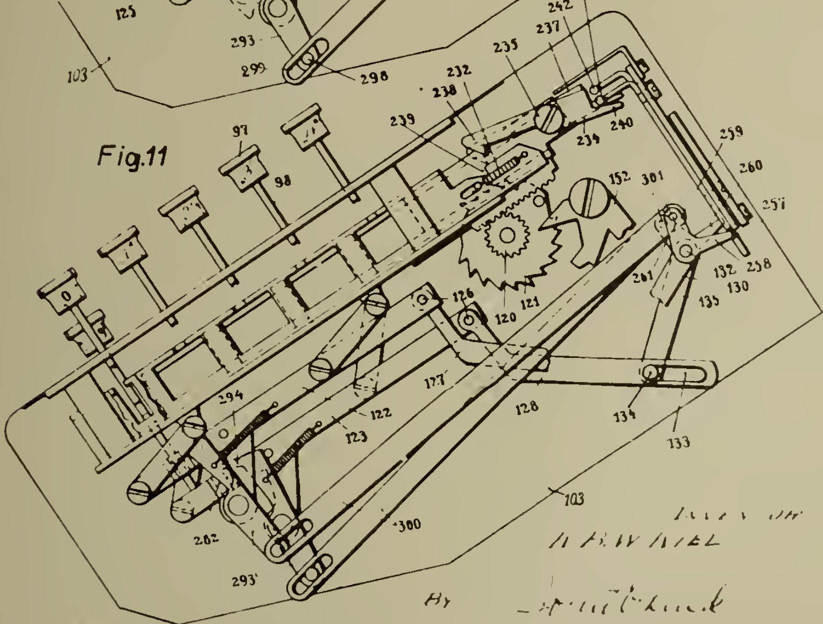


Fig.11



K.B.W. KIEL

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ALIEN PROPERTY CUSTODIAN

COMBS

Lucien Mazzoni, Lyon, France; vested in the Alien Property Custodian

Application filed March 18, 1941

My invention relates to the manufacture of combs from plastic or artificial materials such as cellulose derivatives or artificial resins.

Combs are usually made from such materials by molding. In the cheaper articles, the teeth are directly obtained by molding without any subsequent operation, while in other cases the teeth are cut out in a molded blank. In the teeth obtained by molding the intermediate spaces decrease in width from the tip to the bottom, which is an inconvenience for the user. This is avoided with teeth obtained by cutting, but the cutting operation materially increases manufacturing costs.

A first object of my invention is to provide combs obtained by molding without any subsequent operation, and wherein the spaces between the teeth are regular in width from tip to bottom.

Another object of my invention is to provide a method of molding combs from plastic or artificial materials, wherein the spaces between the teeth are obtained by means of blades engaged through the mold which are removed before the mold is opened.

A further object of my invention is a molding device for combs of plastic or artificial materials comprising a mold having a bottom supported by elastic means on a base provided with vertical blades partially engaged through the said bottom in such a manner that when the top of the mold is pressed on the bottom, the said blades are driven through the mold and are afterwards removed when the pressure of the top on the bottom is released.

In the annexed drawings:

Fig. 1 shows a comb molded according to the known methods without finishing operation.

Fig. 2 is an enlarged partial view thereof.

Figs. 3, 4 and 5 are sections thereof taken along lines III—III, IV—IV and V—V (Fig. 2).

Fig. 6 is a partial section of a blank obtained by molding in the known methods of manufacture involving a cutting operation.

Fig. 7 is a similar section showing the cross-section of the teeth obtained from such a blank by cutting.

Fig. 8 is an enlarged partial view of the comb obtained.

Fig. 9 is a longitudinal section of a molding device according to my invention.

Fig. 10 is a view similar to Fig. 9, but the top being pressed on the bottom.

Figs. 11 and 12 are partial sections taken on lines XI—XI and XII—XII of Figs. 9 and 10.

Figs. 13 and 14 are partial sections similar to Figs. 11 and 12, but showing the parts respectively when the pressure of the top on the bottom is released and when the molded comb is disengaged from the mold.

Fig. 15 is a partial section of a modified mold at the open position.

Fig. 16 shows on an enlarged scale a portion of Fig. 15.

Fig. 17 is a section taken on line XVII—XVII of Fig. 16.

Fig. 18 is a view similar to Fig. 15, but at the closed position of the mold.

Figs. 1 to 5 show a comb with two opposed series of teeth 1 fixed to the same back 2. This comb is directly obtained by molding according to the known methods. As it is well known, the mold is made of two parts, the plane of the comb being coincident with the plane of the joint of the said parts.

In order to avoid breakage of the teeth when the mold is being opened, it has been customary to give the teeth a cross-section more or less similar to a lozenge, as clearly shown in Figs. 4 and 5. Since the thickness a (Fig. 3) of a tooth increases from the tip to the bottom, where it equals the thickness of the back 2, the dimensions of the cross-sectional lozenge also increase, as shown by Fig. 4 which corresponds to a line of section IV—IV (Fig. 2) inclined with respect to the back. The width b of the intermediate space between two consecutive teeth 1 therefore decreases from tip to bottom as shown in Figs. 2 and 4, and with long and fine teeth said space may vanish in the vicinity of the back.

When using such a comb, the hair may be pinched in the narrower portions of the intermediate spaces. This kind of comb is therefore unsatisfactory.

The better combs are generally made by cutting the teeth in a molded blank. Fig. 6 shows the cross-section of such a blank wherein the teeth are not wholly formed and appear as ridges 1′ on both faces of a plain plate 3. The teeth are then finished by cutting by means of rotary cutters or the like and they finally appear as indicated in Figs. 7 and 8. The width b of the intermediate spaces between the successive teeth is regular from tip to bottom. The comb obtained is satisfactory, but its cost of manufacture is high owing to the cutting operation which besides necessitates a subsequent polishing.

According to my invention combs similar to Figs. 7 and 8 are directly obtained by molding without any subsequent finishing operation.

The mold illustrated in Figs. 9 and 11 com-

prises a bottom 4 and a top 5 provided with appropriate recesses 6 adapted for mutual cooperation to mold a comb of the kind shown in Fig. 1, but without any intermediate space between the teeth, i. e. the mold formed by bottom 4 and top 5 when superimposed would produce a plain plate having the shape and the thickness of the comb of Fig. 1.

Bottom 4 is guided by vertical rods 7 fixed to a horizontal base or support 8 and it is elastically supported thereon by springs 9 disposed around rods 7. Top 5 is also guided by rods 7 and it is fixed to a vertically movable member 10 which may be, for instance, the movable head of a molding press.

Base 8 carries two rows of blades 11 disposed in equidistant parallel relation, the upper part of each blade being engaged into a corresponding slit 12 provided through bottom 4 and the said blades being so proportioned that at the open position of the mold (i. e. when the top 5 is raised above bottom 4 as shown in Fig. 9) they do not project in the corresponding recess 6. Top 5 is also provided with blind slits to accommodate the upper ends of blades 11 when the said top is lowered as indicated in Figs. 10 and 12.

Blades 11 are so disposed as to correspond with the intermediate spaces to be obtained between the successive teeth of the comb.

The operation is as follows:

Top 5 is first pressed down on bottom 4. Springs 9 are compressed (Fig. 10) and bottom 4 is lowered whereby blades 11 move upwardly with respect to the mold. They project from bottom 4 and penetrate into slits 13 (Figs. 10 and 12).

The plastic material or molding composition is then introduced into the mold under pressure in the well-known manner. It is hardened in the mold by cooling, by polymerization or by any other appropriate means.

The mold is then opened by raising top 5. At first, springs 9 maintain bottom 4 pressed against top 5, the mold being raised as a whole, whereby blades 11 move downwardly with respect to the mold (Fig. 13) leaving void spaces 14 between the successive molded teeth 1. The latter being firmly maintained between parts 4 and 5, there is no risk of breakage of the teeth.

Top 5 being further raised (Fig. 14) the mold is opened and the molded comb can be removed and used without requiring any subsequent finishing operation.

The plain intermediate portions of the mold between slits 12 and 13 are preferably concave as shown at 15 (Figs. 11 to 14), whereby the cross-section of the teeth is rounded as indicated at 16 (Fig. 14).

In the modification of Figs. 15 to 18 the blades 11 are movable horizontally. The bottom part 4 of the mold need not be elastically supported on the press base.

Blades 11 are fixed to a transverse member 17 guided on bottom 4 by screws 18 passed through elongated slits 19 of bottom 4. Bottom 4 and top 5 are provided with slits 12 and 13 adapted for cooperation with blades 11.

The mold is first closed as shown in Fig. 8 and blades 11 are pushed towards the molding recesses 6 through slits 12 and 13. The molding composition is introduced into the mold and hardened. Blades 11 are then disengaged and the mold is opened.

It will be understood that although the invention has been described with reference to a comb having two rows of teeth, it may also be applied to the manufacture of combs with but one series of teeth. Also the spacing of the teeth may be regular or irregular.

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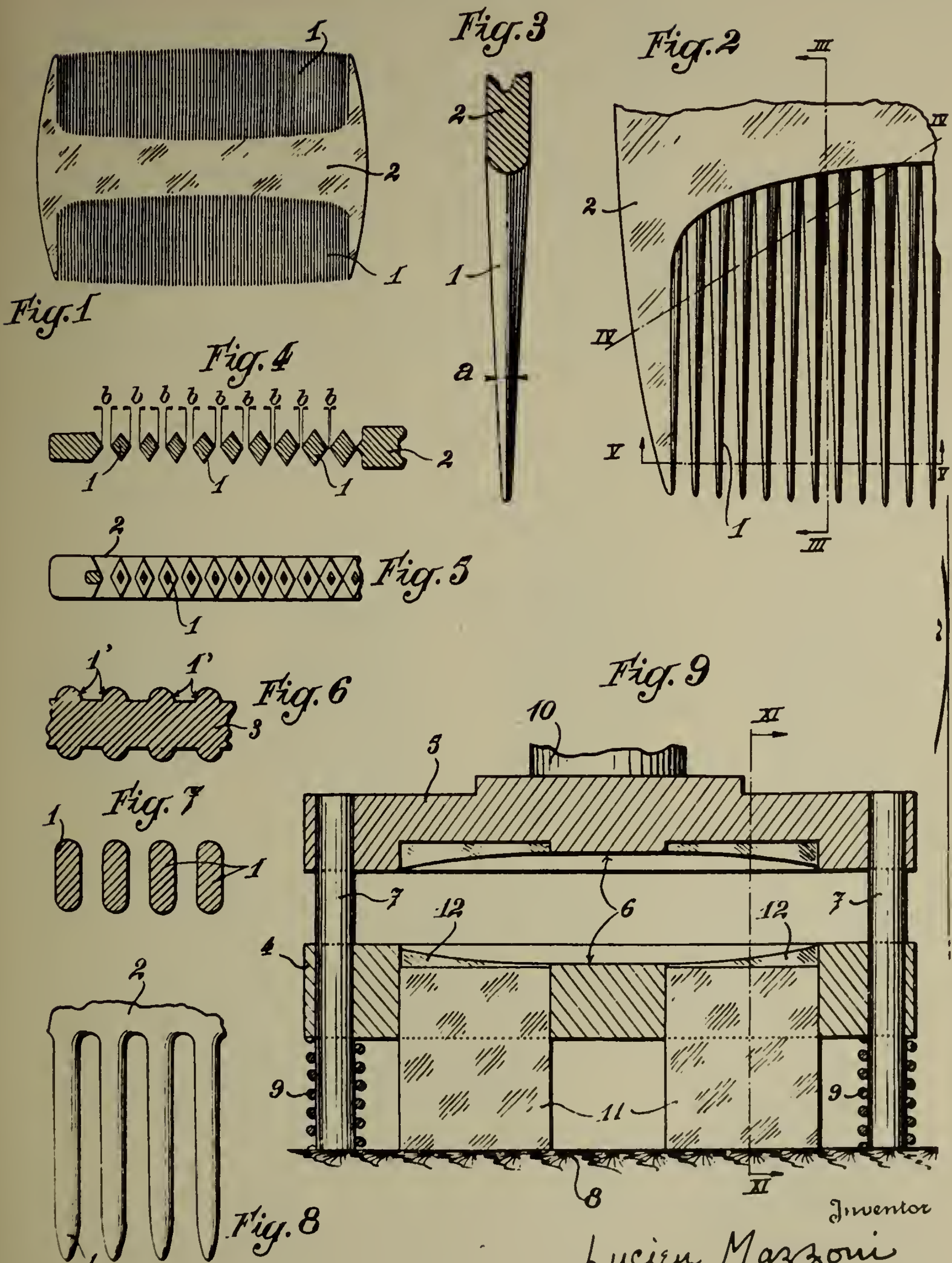

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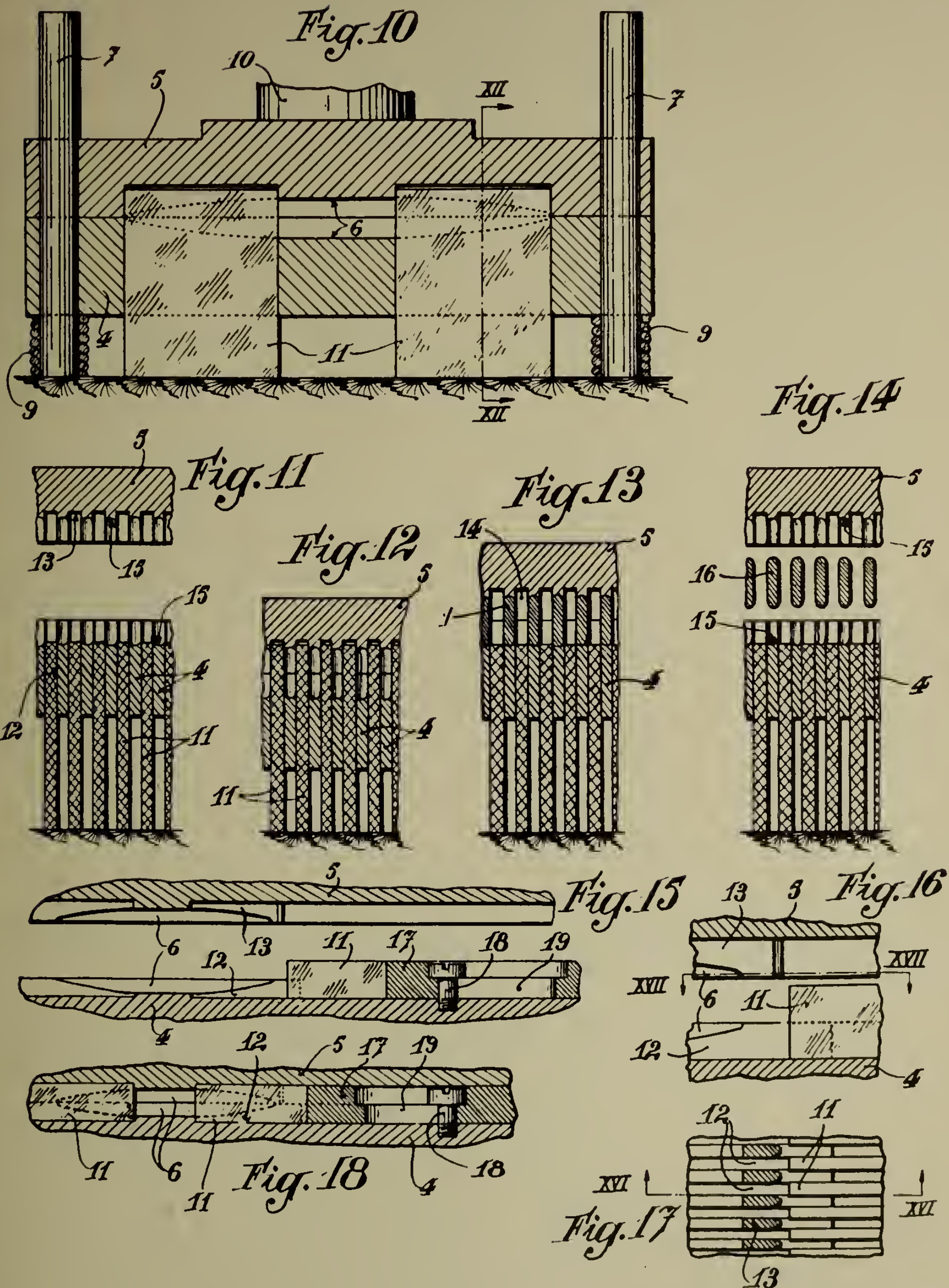
2 Sheets-Sheet 2



INVENTOR.

Lucien Mazzoni

BY

Alexander & Dowell

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Published June 1, 1943

Serial No. 384,096

ALIEN PROPERTY CUSTODIAN

MOUNTING FOR PIEZO-ELECTRIC CRYSTALS

Felix Lehmann, Berlin, Germany; vested in the Alien Property Custodian

Application filed March 19, 1941

This invention relates to a new and useful mounting for piezo-electric crystals in which the one electrode is adapted as casing and bearing part with pointed screws serving for pressing-on the faceted quartz plate.

For the fastening of quartz crystals and more especially in the case of mass production, mounts for the quartz crystal plates are required.

(a) the mounts must be insensitive as much as possible to vibrations,

(b) the capacity of the mounts must be such that it can be adapted without the use of additional means to intermediate wave lengths, short waves and ultra-short waves,

(c) the damping action of the mount is to be such that it can without new production parts, be varied for the particular purpose of the quartz (oscillator, resonator),

(d) the mounts must have favorable heat conducting properties and must not exert any influence upon the temperature coefficient of the quartz crystal,

(e) the mounts should not require precision parts which are difficult to produce in connection with mass production and without thereby jeopardizing the precision of the crystals.

Particularly serious difficulties are encountered in mounting thin quartz plates without danger to them and such that they are insensitive to vibrations and without substantially reducing the quality of the plates.

It is known more especially in the case of crystals for very short waves to clamp-in the quartz plate between two electrodes. However, such mountings have the drawback that the frequency cannot be accurately adjusted since the change of the electrode distance necessary for setting the frequency is not possible. Furthermore, in such mountings the frequency depends greatly on the pressure exerted on the quartz by the two electrodes. This condition causes an increased temperature coefficient on account of the mounting.

Furthermore, a mounting is known in which the quartz is held at the sides in three points, whereby both electrodes are so arranged that they do not come in contact with the quartz while the distance between electrode and the quartz crystal can be adjusted. Such mountings require high precision because the quartz crystal plate is to be adjusted parallel to the variable electrodes. This type of mounting can no longer be employed in the case of very thin crystals, and especially for crystals for very short waves, since lateral pressure exerted upon very thin crystals may cause fracture.

These drawbacks are avoided in the novel quartz crystal mounting whereby the aforesaid requirements are at the same time complied with. The accompanying drawing shows by way of example a mode of construction of the new mounting.

Fig. 1 shows the new mounting in cross-section.

The Figures 2 and 3 represent two different types of mounting the quartz plate on the one electrode.

Fig. 4 shows in an elevational view a double mounting according to the novel idea.

The quartz plate Q rests on a flat metal plate A which serves at the same time as electrode and mount. The counter electrode B is arranged adjustably inside an insulated casing C consisting for instance of a ceramic material, or of high quality insulating material, whereby the insulating part is fastened directly on the counter electrode. In order to fasten the quartz crystal plate Q its edge is faceted and is mounted in a springy, or fixed manner by means of two, or a greater number of conical pins. These conical pins S reach over the edge of the round, or rectangular plate and limit the position of the latter on the metal plate A and in respect to the counter electrode B.

In accordance with the present invention, such a mounting produces no additional damping effects, although the quartz crystal plate is so fastened that it can be displaced in the mounting. By means of the movable electrode B the frequency can be set at will. By a suitable choice and arrangement of the conical pins S (Figs. 2 and 3) the quartz crystal plate can be positioned in the mount.

The new mount can be produced in a simple manner since it requires higher precision only in respect to the level movement of the electrodes A and B. The mode of assembling does not increase the capacity of the mount owing to the fastening elements, the static capacity is at the most equal to the electrode capacity that can be attained. Measurements have shown that despite the unilateral rigid mounting, the quartz crystal practically reveals no higher damping than if it were suspended in an entirely free fashion. Owing to the high heat capacity and favorable heat contact of the quartz crystal with the plate A of the one electrode, a very favorable constancy of the temperature can be easily attained in conjunction with a thermostat.

The special mode of assembly of the new mount affords a considerable reduction in required space as compared with the known mountings a condition which is of particular importance to arranging of these mountings in a receiver apparatus in which owing to lack of space the smallness of this mounting plays an important part.

As is often necessary in practice, two such mountings can be combined to a double mounting in a simple manner (Fig. 4).

A plate P with the connection contacts K has mounted the double crystal support between the lead-in springs V, said double mount being constructed in exactly the same manner as shown in the Figs. 1 to 3.

FELIX LEHMANN.

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F. LEHMANN
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Fig. 1.

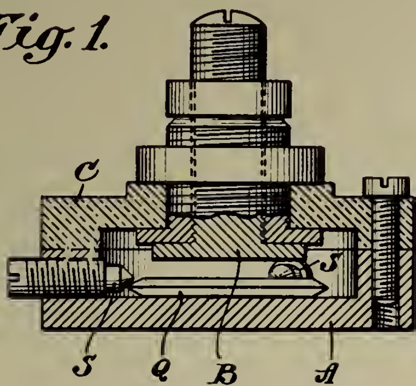


Fig. 2.

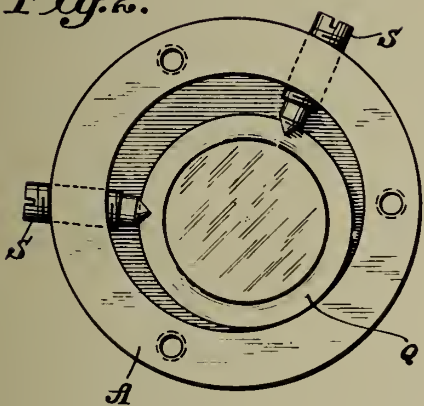


Fig. 3.

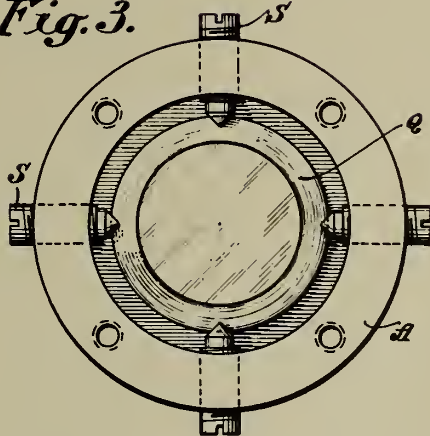
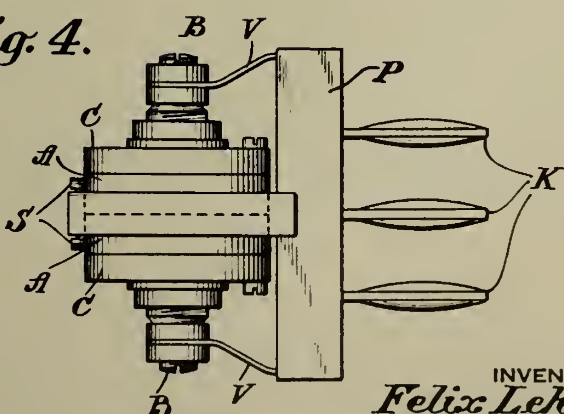


Fig. 4.



INVENTOR
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ATTORNEY

Published June 1, 1943

Serial No. 387,342

ALIEN PROPERTY CUSTODIAN

ARRANGEMENT FOR THE HIGH-FREQUENT HEATING OF BAND-SHAPED METAL, ESPECIALLY FOR THE PRODUCTION OF BRASSES

Herbert Jan Oskar Gumprecht, Wiesbaden, Germany; vested in the Alien Property Custodian

Application filed April 7, 1941

In the production of brasses one may proceed in that band-shaped metal, for instance steel band which has a special cross-section, as shown in Fig. 1 of the accompanying drawing, is continuously heated and that then onto the heated band the corresponding brass-metal is applied in solid or liquid form. After the cooling pieces are cut off the band and pressed to form brasses.

The problem is, to carry out the heating of such a metal band continuously and as rapidly as possible, if necessary with employment of a protective gas. When gas is employed for the heating, the possibility exists that the material oxidizes or combines with constituents of the heating gas. The best possibility for the clean production of such a metal band for brasses is therefore the high frequent heating.

According to the invention, the arrangement for heating the band is constructed so that a tubular heat conductor of circular or rectangular cross-section effects the heating of the metal band moved over the same. A sharply limited heating zone with direction of flow opposite relative to that of the heat conductor is then formed directly above the tubular heat conductor. The returning of the heating current induced in the work is effected by two parallel-connected return conductors of comparatively large cross-section arranged on either side of the heat conductor. In order to ensure a good efficiency of the plant and to avoid straying effects, the whole inductor, consisting of heat conductor and return conductors is narrowly coupled with the work, i. e. with the metal band. Owing to the comparatively large cross-section of the return conductors and the type of the spatial arrangement of the heat conductor relative to the return conductors there is attained, that the current induced by the return conductors produces no or only moderate heating, whereas on the other hand a bifilar effect between the individual conductors is avoided. The bifilar effect would at first cause spreading of the sharply limited heating zone under the main heat conductor and in an extreme case even heating of the work would be rendered impossible. The metal for the brass can be applied in liquid or powdrous state onto the narrowly limited heating zone, and then, when the relatively high temperature necessary for melting the brass metal has been attained, this brass metal can be joint with the metal band.

In Figs. 2 and 3 of the accompanying drawing an embodiment of the inductor is illustrated. **1** designates the heat conductor and **2**, **3** designate the return conductors which, in the example illustrated, are of box-shaped cross-section. Owing to the comparatively high current density, especially in the heat conductor **1**, the whole inductor is preferably water-cooled. The inductor is connected to the source of high frequency at the points **4** and **5**. The metal band **6** is moved over the inductor transversely to the longitudinal direction of this inductor.

HERBERT JAN OSKAR GUMPRECHT.

PUBLISHED

JUNE 1, 1943.

BY A. P. C.

H. J. O. GUMPRECHT

ARRANGEMENT FOR THE HIGH-FREQUENT HEATING
OF BAND-SHAPED METAL, ESPECIALLY
FOR THE PRODUCTION BRASSES

Filed April 7, 1941

Serial No.
387,342

Fig. 2

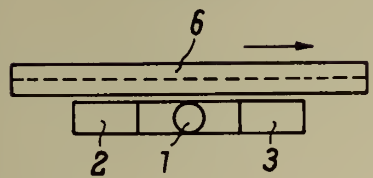
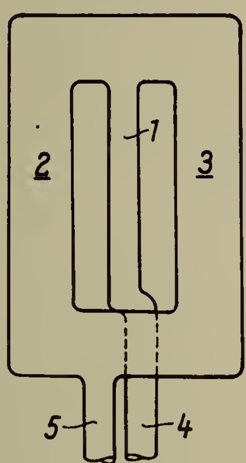


Fig. 1

Fig. 3



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Serial No. 388,753

ALIEN PROPERTY CUSTODIAN

DEVICE FOR INTERRUPTING OVERLOADS

Fritz Kesselring, Berlin-Frohnau, Germany; vested in the Alien Property Custodian

Application filed April 16, 1941

The present invention relates to a device for interrupting overloads.

The interruption of overloads is effected the simpler, the quicker the interrupting device reduces the current value. This may be accomplished according to the invention by the use of a resistance switch which is released by means of a fuse. In this case by a resistance switch, a device is to be understood, by means of which a resistance is rendered effective in a very rapid manner in the circuit to be interrupted. The rapid operation of the device controlling the resistance is, however, completely utilized only if this control device can be released also very rapidly. To this end, a fuse is employed according to the invention, since it is possible to attain with the aid of the latter very high releasing speeds. The combination of a resistance switch and of a fuse releasing the same enables an effective suppression of the overload already upon the occurrence thereof.

The fuse may be arranged in the form of a fusible cut out. Since it, however, has not the function of the ordinary fusible cut outs but is supported or replaced by the resistance to be inserted in the circuit when disconnecting the current, it may be proportioned considerably smaller than the ordinary cut outs. Above all it is made shorter, since an arc produced at the point where the fusion occurs need not be feared, because it is weakened by the immediate insertion of a resistance and is therefore extinguished rapidly or may be extinguished with the simplest means.

An embodiment of the invention is shown in the accompanying drawings in diagrammatic form.

In the circuit *u*, *v* to be interrupted, the resistance switch consisting of a resistance body *w* and a contact *s* sliding thereover is connected in series with the wire fuse *a*. The wire fuse is enclosed in an insulating tube or cylinder *r* and connected with the contact *s* through an electrically conductive connecting member *g*. The contact *s* is pulled in the direction as indicated by the arrow by a power storing device, for instance, in the form of a stretched spring *f* and is held in the position of rest against the action of the spring by the wire *a* before the latter is fused. If the wire *a* fuses the spring *f* pulls the contact *s* very rapidly towards the other end of the resistance body *w*, the current is immediately reduced to a considerable extent by the resistance becoming effective and extinguishes the arc caused by the fusion of the wire *a*. To support the extinction of the arc occurring at the wire fuse it is preferable to arrange in a known manner in the neighborhood either gas developing insulating materials or to arrange the wire fuse in a pulverized insulating material; for instance, in quartz.

The vapors developed during the fusion of the wire *a* may also be utilized to accelerate the movable part of the resistance switch. To this end, a piston *k* which is guided in the tube in a sufficiently tight manner is interposed between the wire fuse *a* and the connecting member *g* designed in the form of a rigid rod. The piston *k* is forced by the gas pressure caused during the fusion within the fusing chamber towards the open end of the tube and thereby supports the driving force of the spring *f*. The wire fuse is connected to the current supply conductor *v* through the conductive bottom *b* of the tube *r*. The spring *f* is insulatedly secured to the movable contact *s*. The insulating part and the insulating supports on which the tube *r* and the resistance body *w* are firmly mounted are denoted by the reference character *i*. The spring *f* may also be replaced by a power storing device of another type, for instance, by an energized electromagnet.

In this manner a cut-out for currents of great intensity may be easily produced which operates in response to an overload within the shortest time and which in connection with the resistance switch interrupts the current without dangerous arcs being formed.

FRITZ KESSELRING.

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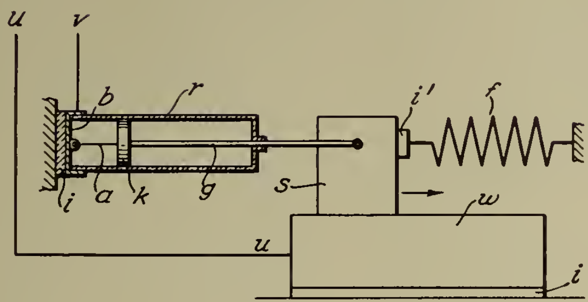

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BY Burgess
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Published June 1, 1943

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ALIEN PROPERTY CUSTODIAN

WELDED CRANK CASE

William Werner, Chemnitz, Germany; vested in the Alien Property Custodian

Application filed April 25, 1941

The invention relates to a welded crank case especially for multi-cylinder piston engines, the engines being arranged in a row, the crank case being composed of several transversely directed web walls and of several longitudinally directed cover and side walls at the ends of these transverse walls, every two or three sheet metal walls consisting of one single pressed part, which is bent off either at one angle in L-shape or at two angles in U-shape.

In the known crank cases of this type the pressed parts bent off in L-shape or U-shape form directly the case walls, the adjacent arms of the pressed parts being either overlap- or butt-riveted or blunt welded at their joints. Sheet metal plates of comparatively great thickness must be used for these one-wall cases, said thick sheet metal plates requiring considerable bending work and after the bending also considerable adjusting work, in order to be adapted the one to the other. The simplification of the production by uniting several case walls in one pressed part is therefore only apparent as the saving in welding work is more than compensated by the subsequent bending work and by the increased adjusting work.

Compared herewith the invention consists therein, that the pressed parts bent off in L-shape or in U-shape are pushed together crosswise or parallel the one to the other and welded together in forming double walls. Hereby an extremely light and stable but also cheap case can be produced from comparatively thin sheet metal plates, about 1 to 1.5 mm thick. In this instance the sheet metal plates themselves are no longer decisive for the stresses occurring in the service, but the hollow girders formed by the putting together of these sheet metal plates, so that the final strength of the completed case amounts to a multiple of the internal strength of the individual pressed parts. By the possibility, to employ extremely thin sheet metal plates, not only the pressing out of the case walls but also the subsequent bending work is much simplified; the saving in welding work due to the simultaneous pressing out of several case walls in continuous shape can, in this instance, not be consumed any more by the additional bending work. Owing to the fact that the pressed parts are built of rather thin sheet metal plates the subsequent adjusting work can be restricted to simple calibrating.

An embodiment of the invention is illustrated by way of example in the accompanying drawings, in which

Fig. 1 shows a vertical section through the crank case, in the left hand half along the central cylinder plane Z and in the right hand half along the line I—I of Fig. 4.

Fig. 2 a section along line II—II and

Fig. 3 a section along line III—III of Fig. 1,

Fig. 4 is a top plan view of the crank case,

Fig. 5 a side elevation of the crank case and

Fig. 6 a part section similar to Fig. 1 for a slightly different construction.

The crank case consists of several transversely directed web walls A—A and of several longitudinal walls, i. e. a cover wall B_i—B_a, two side walls C_i—C_a at the ends of these web walls, these longitudinal walls being double walls of thin sheet metal plates. The outer side plates C_a are united in this instance with the outer covering plate B_a, and the inner side plates C_i each one with a web plate A to form a U-shaped pressed part. These pressed parts C_a—B_a—C_a and C_i—A—C_i are each stamped plane from a piece of sheet metal, the apertures, such as windows 7, holes 24, and bulges 13_b being formed, the plates being then pressed plane, in forming the bulges 3, 15, 16, 20*a*, 22, grooves 12, 25*a* and ribs 8, 9, 26*a*, and are finally bent off twice at an angle at 35 or 36 respectively, so that the plates assume the shape suited for building in. In this shape they are cut to accurately similar sizes, calibrated, and then pushed together crosswise, in order to be connected the one with the other by welding in forming double walls.

The putting together of the pressed parts is effected in the following manner:

Every two pressed sheet metal parts C_i—A—C_i having outwardly directed arms C_i are joined in that they are point-welded in the transverse central plane Y of the web, with formation of hollow girders 4 between the bulges 3 and the ribs 8 and 10. Hereby individual transverse bulk heads are provided, which can then be placed in a row, their adjacent arms C_i joining the one the other in the transverse central plane Z of the cylinder. By butt-welding along their joints 37 the transverse bulk heads are united to form an inner frame which, considered alone, evidently possesses only little stiffness.

The inner covering plate B_i is then placed on the web B_a of the pressed part C_a—B_a—C_a and both sheet metal plates are point-welded in forming hollow girders 17, 18 along the bulges 15, 16 at 19; both sheet metal plates are further blunt-welded at 38 with formation of carrying rings 13 for the cylinder inserts. An outer frame is

thus produced which, considered alone, possesses also only little stiffness.

Finally, the outer frame is pushed from above over the inner frame, so that the sheet metal plates C_i, C_a supplement each other to double walls. Both parts are then connected the one with the other by repeated point-welding, on the one hand with formation of the hollow girders **23**, at both sides of the bulges **22**, and on the other hand with formation of the hollow girders **21**, **20**$_b$, at either side of the bulges **15**, **20**$_a$, and besides by simple blunt-welding at **39** with formation of the carrying ring **25**$_a$. The frames thus united supplement the one the other as regards strength to a space-stiff bond, which can withstand all stresses occurring in the service.

On the crank case two U-shaped bars D are then placed from the sides and point-welded at **31** the one with the other to form a box-shaped hollow girder **23**. The bars D have vertical bores for the foundation sinkers **34**. The crank case is then closed at the bottom by bottom plates E which are point-welded at **32**. No subsequent treatment of this crank case is necessary.

Instead of uniting the sheet metal plates C_i, C_a to one pressed part C_i—A—C_i, the sheet metal plates C_i, B_i may be united, as shown in Fig. 6, to a U-shaped pressed part C_i—B_i—C_i, which is pushed parallel into the pressed part C_a—B_a—C_a and welded with the same in forming double walls.

As shown in Fig. 3 the bending edges **36** of the pressed parts C_i—A—C_i may be equipped with longitudinally extending bulges **40**, which are closed to form hollow girders **21** by connecting with the pressed part C_a—B_a—C_a, which especially stiffens the case in the transverse direction. As shown in Fig. 6, the bending edge **35** of the pressed part C_a—B_a—C_a may be equipped with a longitudinally extending bulge **41**, which is closed to form a hollow girder **42**, by its connection with the pressed part C_i—B_i—C_i, this hollow girder especially stiffening the case in the longitudinal direction.

WILLIAM WERNER.

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BY A. P. C.

W. WERNER

WELDED CRANK CASE

Filed April 25, 1941

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3 Sheets-Sheet 1

Fig.1

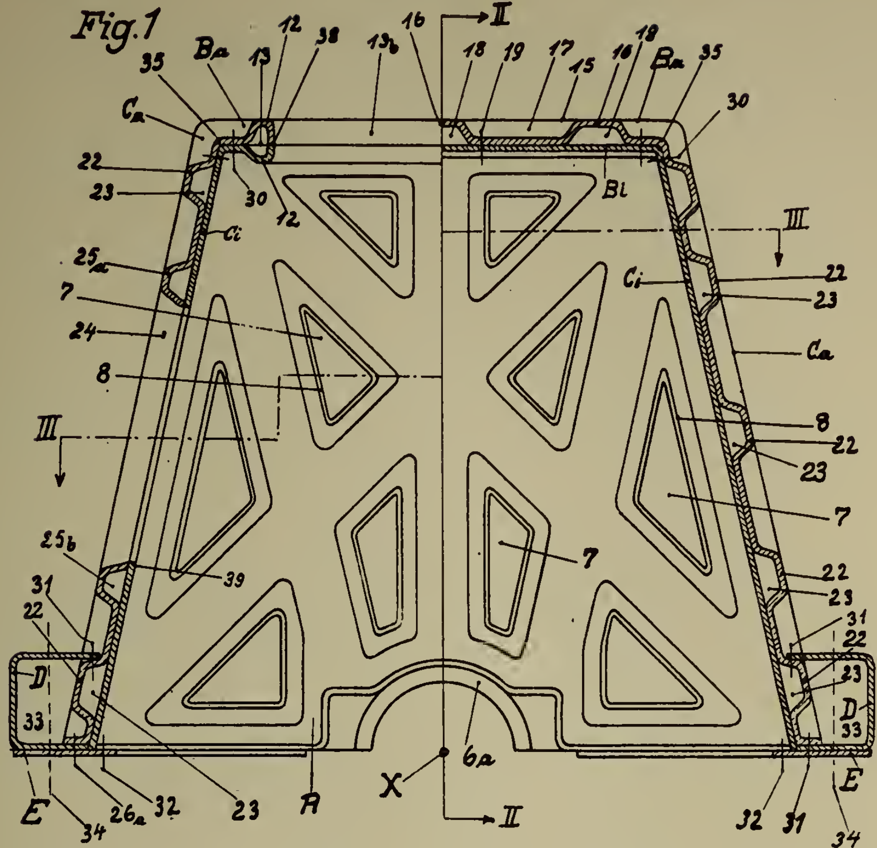
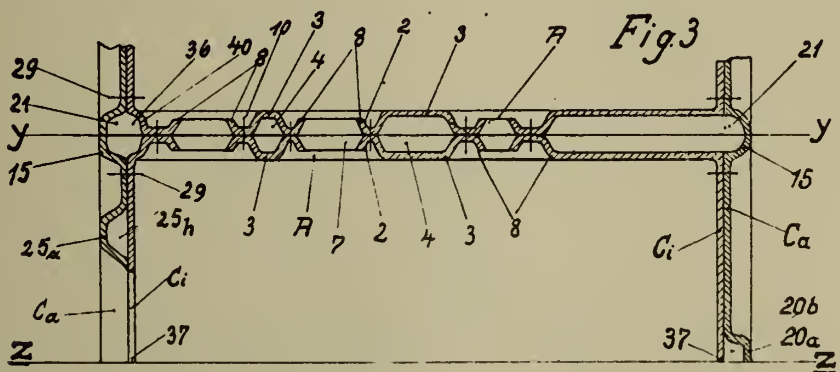


Fig.3



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BY Richards & Geier

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PUBLISHED

JUNE 1, 1943.

BY A. P. C.

W. WERNER

WELDED CRANK CASE

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Serial No.

390,240½

3 Sheets-Sheet 2

Fig. 2

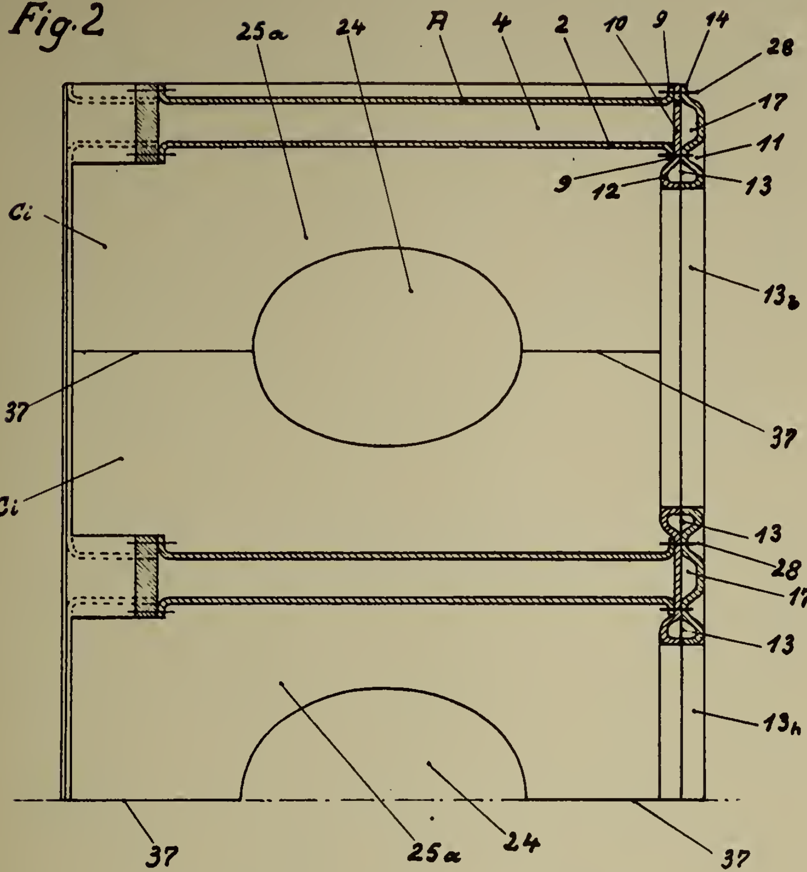
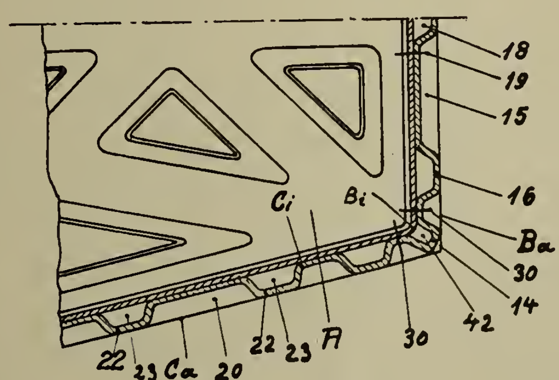


Fig. 6



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WELDED CRANK CASE

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390,240 ½

3 Sheets-Sheet 3

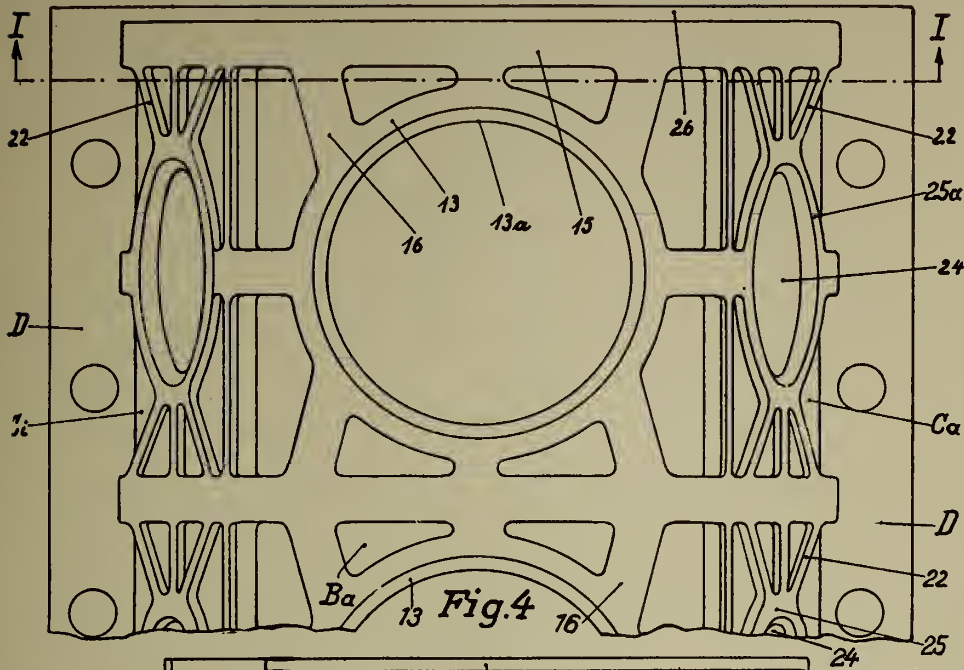

Fig.4

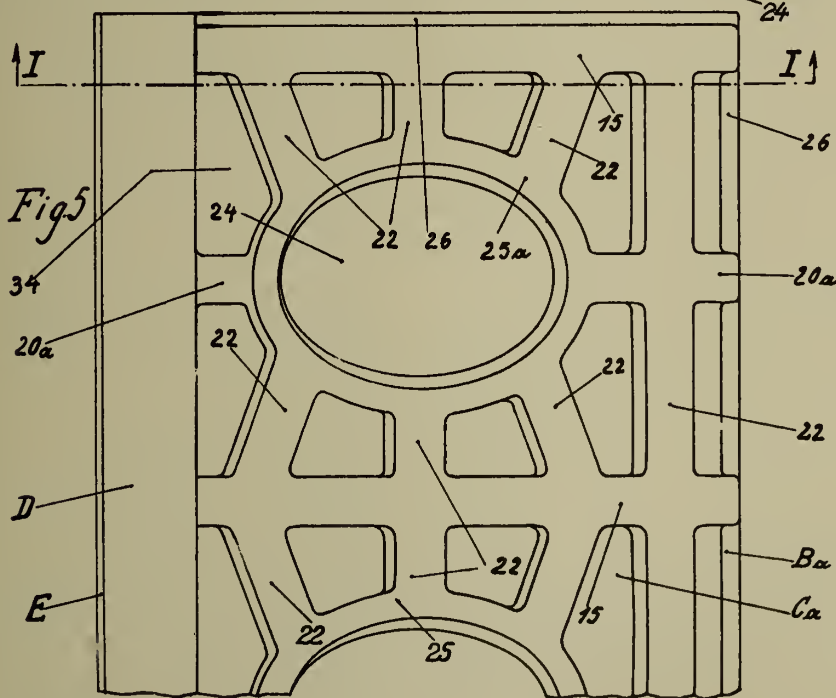

Fig.5

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ATTORNEYS

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ALIEN PROPERTY CUSTODIAN

PROCESS AND A DEVICE FOR PRODUCING IRON OR IRON ALLOYS

Fritz Eulenstein, Koln A/Rhein, and Adolf Krus, Sturzelberg uber Neuss II, Germany; vested in the Alien Property Custodian

Application filed April 29, 1941

This invention relates to a process and a device for producing iron or iron alloys by reducing iron ores in rotary drum furnaces operated by successive charges.

In the production of iron or iron alloys in furnaces of this class the charge comprising iron ores and reducing agents and possibly also additions like lime etc. is directly heated by the hot furnace gases until the iron or iron alloys have been melted. As the gases flowing away from the furnace have still a very high temperature, their heat content has been utilized for preheating the ore or the charge in muffles or continuously operated cylindrical rotary kilns or for heating air heaters in which the air for combustion required for the operation of the reduction furnace is heated. The utilization of the waste gases of the reduction furnace involves, however, serious difficulties, since experience has shown that in all known devices utilizing the heat of such gases extensive accretions were formed or the brickwork melted away. This is due to the fact that the waste gases coming from a reduction furnace carry along dusty particles of the charge as well as ashes of the fuels used in firing the furnaces or volatilized portions of the charge. These substances, finely divided in the waste gases, enter into reaction with the masonry structure of the device connected with the furnace, so that either sintered or molten reaction products result, depending on circumstances.

According to the invention it has now been discovered that the said sintering or melting does not occur when the waste gases on coming out of the reduction furnace are first passed through an apparatus in which they serve for directly heating difficultly fusible substances like limestone, dolomite, magnesite, raw cement material to be burned, raw fireclay or similar refractory material, zinc oxide to be sintered etc. After the temperature of the waste gases has in this way been materially reduced, for instance several hundred degrees, the gases, even if still containing considerable amounts of dust, may be used without hesitation for preheating the charge or the ore, or the air for combustion, in the usual apparatus, or may successively serve for both purposes and possibly also for heating the reducing agent if the latter is to be preheated separately from the ore and other constituents.

The devices in which the difficultly fusible substances are to be heated with the aid of the hot waste gases of the reduction furnace may have the form of rotary furnaces which either continually move in the same direction or are alternately revolved to and fro. Preferably, rotary furnaces operated by successive charges are employed, since it has been found that in a furnace of this type troublesome sintering or melting phenomena can best be avoided, even if in the reduction furnace ores are worked which produce easily fusible flue dust or from which during their reduction large quantities of volatile substances, as zinc oxides, lead oxides, etc., are driven out.

The furnace or heat exchanger for heating the difficultly fusible substances is preferably installed in the direction of the axis of the reduction furnace to permit the furnace gases to flow without shock through the reduction furnace and the connecting heat exchanger. In some instances it is advisable to construct this heat exchanger in such manner that its cross section decreases from the inlet to the outlet of the gases.

When lime, silica, alumina or similar substances or mixtures of substances are heated in the exchanger with the waste gases of the reduction furnace, they may subsequently in hot condition be brought into the reduction furnace if the operation of the latter requires such additions.

After their passage through the furnace serving for heating difficultly fusible substances, including on occasion also very difficultly fusible iron ores, the gases of the reduction furnace may be guided through an inclined rotary tube through which the ore, separately or together with one or more constituents of the charge or parts of such constituents, is led in parallel or counter-flow thereto. Subsequently, the gases may be utilized for heating the air supplied to the burner of the reduction furnace, or they may serve first for air heating and then for preheating the ore or charge. If their temperature is thereafter still high enough, they may be used in additional heat exchangers, for instance for preheating a reducing agent like coke, lean coal, etc., in case preheating of the reducing agent is to be carried out separately from preheating the ore, or for generating steam or the like.

It is further possible to preheat the difficultly fusible substances by the hot waste gases of the reduction furnace in an inclined continuous revolving tube or to arrange the utilization of their heat in such manner that first in the lowest part of such a revolving tube high-melting point substances and then in the upper part the ore either separately or together with other constituents of the charge are heated.

The ore or the charge and the air of combustion can be preheated also in other known devices.

If the constituents of the charge are not jointly but separately preheated, they are preferably mixed before they are introduced into the reduction furnace, for instance by simultaneously placing them in a bunker or charging vessel or by simultaneously feeding them to the furnace.

The invention is illustrated by way of example in the accompanying drawing, in which

Figure 1 is a plan view of a furnace plant according to the invention;

Fig. 2 an elevation thereof; and

Fig. 3 a side elevation thereof.

1 denotes a rotary furnace in which iron ores, nickel ores, copper ores, etc. are reduced and which rotates in known manner on two rings 22 in corresponding bearings on a turntable 2, so that the two front sides of the furnace 1 can alternately be brought near the burner 3 as required. In the embodiment shown the burner is assumed to be a pulverized-coal burner, the powdered coal flowing from a bunker 4 into a piping 6 through which by primary air passing therethrough, it is forced into the burner 3 and then into the furnace. Secondary air enters through a piping 5. The furnace 1 can be charged in known manner either in inclined position from an elevated bunker, bucket etc. or in horizontal position by a charging device.

The waste gases coming from the furnace 1 and having a temperature of approximately 1300 to 1400° C enter a drum 8 in which difficultly fusible substances are heated which at the waste gas temperature do not appreciably melt or slag. For example, limestone is heated and burnt in the drum 8. Between the drum 8 and the furnace 1 no sealing is required, and a gap may be left, particularly when the waste gases of the reduction furnace 1 still contain combustible constituents, through which due to the furnace draft false air is drawn in which serves for burning the combustible constituents. The limestone or other material is preferably fed in charges to the drum 8 from a superposed bunker through openings in the shell or front sides of the drum, which approximately correspond to large tapholes or through openings in the front side of the drum. Through these openings also the dead-burnt lime may be discharged.

From the drum 8 the waste gases cooled down to about 1000° C or lower pass through a pipe or bend 9 to a furnace 10 having an enlarged zone 11, the bend 9 terminating preferably in the zone 11 or at a still farther point inside the drum or rotary furnace 10 which operates continuously. In the furnace 10 the ores to be reduced are first dried and then highly preheated, whereupon they pass through an intermediate bunker 12 into a charging car 13 disposed below which conveys the preheated ore to the furnace 1.

The ore is fed to the furnace 10 by means of an inlet pipe 14. From the rotary furnace 10 the waste gases having now a temperature of about 700–800° C flow through a flue 15 into an air heater, e. g. a metal recuperator 16, and from the latter into a drier 17 for the reduction material. A piping 18 leads the waste gases cooled down to approximately 200–300° C. into the stack or, if the ores contain volatilizable metals, into a filter and then into the stack. The air required for combustion is forced into the recuperator 16 by a ventilator 19 and a cold air conduit 20 and through the hot air conduit 21 enters in preheated condition the two pipings 5, 6.

The heated lime in the furnace 8 is also discharged into the car 13, and likewise the reduction material in the preheater 17. The allotted quantities are accurately weighed and constitute the charges for the reduction furnace 1 to which they are fed either directly or through an intermediate bunker.

The preheating furnace 10 and connecting apparatus may be so dimensioned as to connect therewith a second or more iron reduction furnaces, as indicated in the drawing by the dotted gas conduit 23 which would then correspond approximately to the bend 9, so that between it and the associated reduction furnace a drum 8 would be interposed. 24, 25 are the rings of the furnaces 8, 10 which may be arranged and rotated in known manner.

The mode of operation is by way of example as follows:

After the furnace 1 has been charged with, say, highly preheated ore and limestone as well as with perfectly dried and preheated reducing material the burner 3 is started. At the beginning of the process the furnace 1 rotates slowly, but after some fritting of the fine ore particles occurs it may be rotated more quickly. As the waste gas temperatures are at first not particularly high, it is advisable to charge the furnace 8 later on, it being not necessary in this respect to make the duration of the treatment of the material in the furnace 8 coincide with that in the furnace 1. The furnace 8, independently of the furnace 1, may be discharged and charged during operation not only once but several times if necessary.

The charge for the rotary furnace 10 depends above all upon the quantity of the iron ore worked in the furnace 1 or, if two or more reduction furnaces work with the furnace 10, upon the amount of material smelted in the connected reduction furnaces. The recuperator 16 can be so amply dimensioned as to be capable of preheating the air of combustion for two or more furnaces, and the same applies to the drier 17 for the reducing material. The capacity of the drier 17 may be chosen at will, and the discharge of the dried and preheated material therefrom may take place independently of the operation of the furnace 1. Preheated ore, hot burnt limestone or reduction coal, or two or all of these substances may be additionally fed to the reduction furnaces during the duration of the charge.

The speed of the furnace 8 also depends on the nature of the operation and is for instance extremely low during deacidification of limestone, when it amounts f. i. only to a quarter turn in six minutes.

The reduction furnace 1 may be provided with a basic, neutral or acid lining, and the lining of the drums 8 and 10 should also be adapted to the work done therein. With respect to the furnaces 8, 10 plain refractory material like fireclay will as a rule be sufficient, since the wear is very low and the cooling due to the material to be treated in the furnaces protects the lining in excellent manner. As the waste gases come out of the furnace 8 at a temperature of about 1,000° C., the connecting piping or the bend 9 is subjected only to slight stressing. Instead of iron ores other ores of high-melting point metals, as oxidic nickel ores or copper ores or corresponding metallurgical products or waste, etc., may be treated in the reduction furnace.

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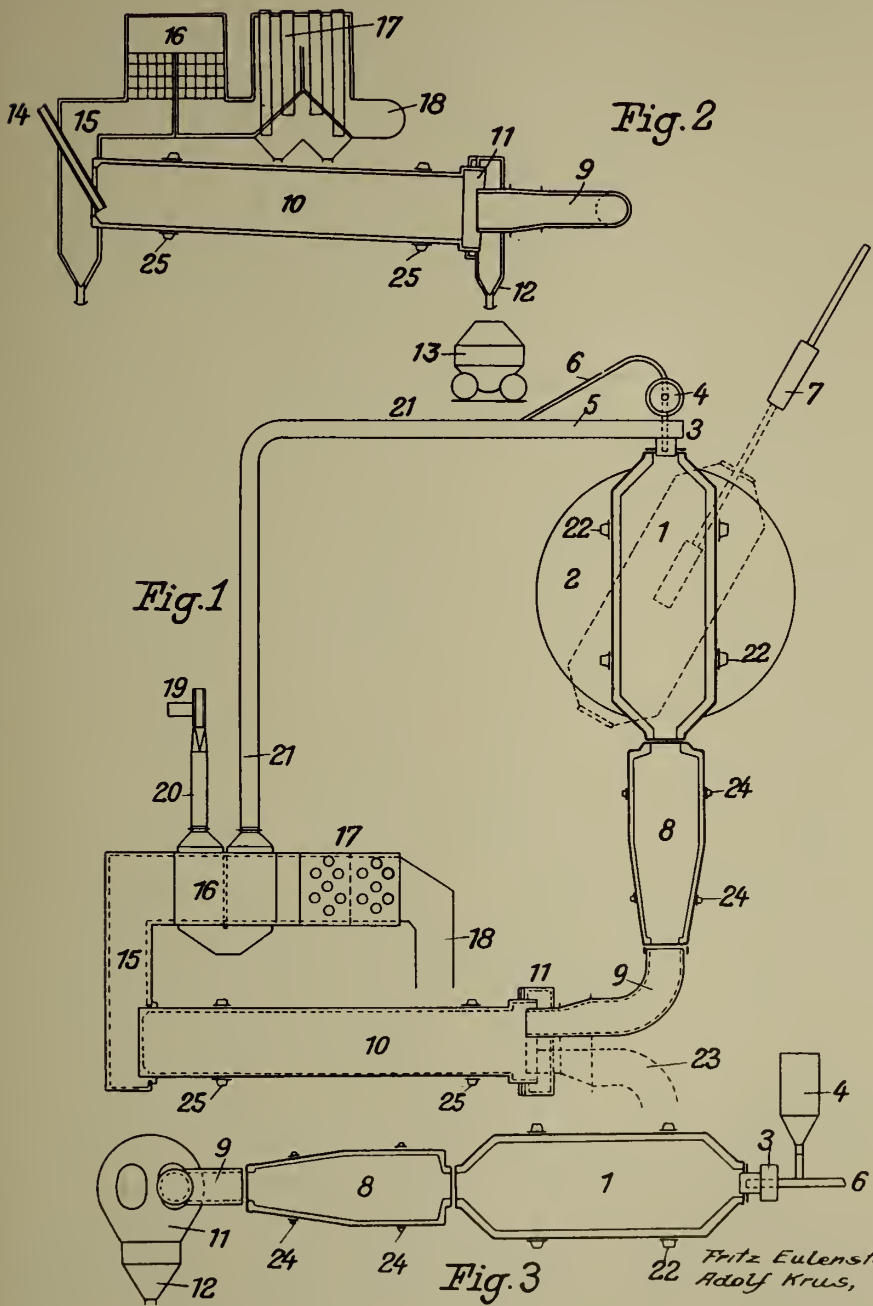

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ALIEN PROPERTY CUSTODIAN

GYROSCOPES

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Application filed May 7, 1941

The invention relates to gyroscopes, such as are employed in airplanes for navigation and control purposes. It is essential that such gyroscopes occupy as small a space as possible. The gyros employed, for instance, in azimuth gyros and horizon gyros are, as a rule, suspended in gimbals. The gyro itself is in most cases arranged in a closed casing which forms the inner gimbal ring and the casing is pivotally mounted in an outer gimbal ring.

The gyro casing may consist of a sectional spherical casing. According to the invention the spherical casing of the gyro is designed in such a manner that the parts of the spherical casing made preferably of two spherical parts may be assembled with the aid of a bracing member extending diametrically through the casing and that the bracing member serves at the same time as an axis of rotation for the gyro flywheel mass designed in the form of an outer rotor.

In the accompanying drawing is shown an embodiment of such a gyroscope in diagrammatic form.

The casing of the gyroscope is designed in the form of a spherical casing and consists of two parts 1 and 2 substantially of the same size. The spherical part 2 is provided with a flange 3 which cooperates with a circular shoulder 4 of the part 1. The joint 5 between the two spherical parts does not extend exactly in the central plane perpendicular to the axis of rotation, but is displaced with respect to this plane by a small amount. In this manner it is possible to provide at any point of the spherical part pins which lie in the said central plane or to provide corresponding flanges for such pins. Under circumstances the flange 3 may have a fitting face on the shoulder 4.

The two spherical parts may be assembled with the aid of a bracing member extending diagramatically through the casing and the bracing member serves at the same time as an axis of rotation for the gyro flywheel mass designed in the form of an outer rotor. Consequently, the axis of rotation is fixedly mounted in bearings. Both ends of the bracing member are provided with threaded portions 7 and 8 which serve to brace the two spherical parts. Each of these two threaded ends cooperates with a nut 9 and 10 respectively. These nuts serve as tightening nuts and are arranged in corresponding recesses 11 and 12 provided in the two spherical parts and cooperate with the axis 6 to brace the two spherical parts 1 and 2 which therefore form a completely closed casing for the gyro, the nuts being flush with the spherical surface of the casing.

The gyro axis 6 forming the bracing member for the two spherical parts is made of two parts. The one part 13 of the axis of rotation is provided with a threaded portion 14 which cooperates with a corresponding threaded portion 15 of the other part 16 of the axis of rotation. Consequently, the part 13 is designed in the form of a screwed joint (screwed cap), the part 13*a* of which surrounding the part 16*a*. Between the parts 13*a* and 16*a* is provided a fitting face by means of which the axis of rotation is centered as well as the two spherical parts with respect to the axis, since the two spherical parts with the fitting face are arranged on the corresponding parts of the axis of rotation. The stator field winding of an electric gyro drive is secured to the part 13 of the stationary axis of rotation 6. The stator laminations are denoted by the numeral 17 and the stator winding by the numeral 18. To supply current to the stator winding, the part 13 of the axis of rotation is provided with an axial bore 19 and a radial bore 20 which are lined with insulating material 21 so that the current may be supplied to the inside of the gyro casing in a simple manner.

The axial cross-section of the inner space of the casing is adapted to the axial cross-section of the gyro rotor in the manner that the gyro rotor moves with the smallest possible clearance within the casing. The gyro rotor is made in the present embodiment of three parts. The rotor laminations constitute the central part 22 of the electric drive which consists of a three-phase squirrel-cage rotor. The rotor copper is denoted by the numeral 23 and has corresponding armature bars 24 as well as short-circuiting rings 25 connecting the same. The teeth of the rotor are denoted by the numeral 26. The two lateral parts 27 and 28 arranged symmetrically with respect to the central part are firmly secured to the central part by means of screws 29 and 30. To increase the gyro couple the lateral parts may consist of a material of high specific gravity, for instance of a highly refractory metal.

The gyro rotor is rotatably mounted on the stationary axis of rotation with the aid of ball bearings 31 and 32. To support the gyro rotor, particular supporting members 33, 34 are provided which are secured in the embodiment shown to the central part of the rotor by means of the screws 35 and 36. The latter may, however, be dispensed with and the tightening of the supporting member 33 and 34 may be effected by means

of the parts 27 and 28 which in turn are secured to the central part by means of the screws 29 and 30. These supporting members are designed in the form of disks and the inner edge thereof is provided with a hub-shaped flange 37 and 38 respectively which are firmly secured to the bearing rings 41 and 42 resigned in the form of magneto-type ball bearings by means of the screws 39 and 40. Between the fastening flange arranged on the outer edge and the hub-shaped flange arranged on the inner edge is provided a diaphragm resilient intermediate part 43 and 44 respectively. With the aid of the above-mentioned supporting members the gyro rotor may be mounted in a particularly advantageous manner to compensate for the expansions of the gyro rotor due to heat. When the gyro is assembled these supporting members are placed under tension, taken up by the magneto-type bearing of the two bearing rings 41 and 42. The tension is brought about by the fact that the diaphragm-like intermediate part is made resilient. The tension is calculated on the base of a non-revolving gyro and so chosen that it disappears upon the occurrence of thermal expansions of the gyro in operation, i. e., if the gyro rotor revolves at the operating speed. Fluctuations of heat with the gyro in operation are relatively insignificant as compared to the expansion when passing from the state of rest to the state of operation. By mounting the gyroscope in the manner mentioned above the bearing friction is not influenced or only to a slight extent as a result of the expansions due to heat and on the other hand particular auxiliary means are avoided as are employed in the known arrangements in which these means are in part very complicated and in part do not bring about the desired effect. A further advantage presented by the symmetrical arrangement of the supporting member in relation to the central part of the gyro rotor consists in the fact that with respect to the central plane the expansions of the central portion exert the same action in the supporting members at both sides. In this manner the position of the center of gravity of the gyroscope is practically uninfluenced by the expansions due to heat. In the diaphragm-like intermediate members are provided corresponding bores for the screws 29 and 30 so that the said parts do not come into contact with these screws.

The joint 5 as well as the joints between the nuts 9 and 10 and the corresponding recesses 11 and 12 in both parts of the casing may be sealed by means of a suitable packing so that the casing is completely air-tight. In this manner the penetration of moisture, dirt and the like is prevented.

The rotor copper bars may be amply dimensioned so that no undue heating up of the three-phase drive is to be expected. It is therefore not necessary to provide particular air passages or the like through which the interior of the casing is brought into communication with the outside atmosphere.

The gyro rotor is made of three parts having the cross-section shown in the drawing. It is also possible according to the invention to give the gyroscope any axial cross-section and to design the axial cross-section of the inner space of the casing in a corresponding manner. The three parts of the gyro rotor are secured by means of screws or in any other suitable manner. For instance, a connection with the aid of a screw thread may be provided for the two lateral parts, one portion of the thread being arranged on the central part and the other portion of the thread on the corresponding lateral part. The connection of the disk-shaped supporting members of the gyro rotor with one part of the ball bearing may be effected in any suitable manner instead of with the aid of screws. Furthermore, the supporting members made of one piece as shown in the embodiment may also be made of several pieces. Thus, for instance, the diaphragm-like central part may consist of a disk-shaped part which is then secured to a particular outer ring and an inner ring. To secure the two spherical parts screws may be provided, for instance, in the flange 3 and shoulder 4 which may be employed to prevent the two spherical parts from rotating with respect to each other. The gyro casing may consist of any suitable material. A ferro-magnetic material is preferably employed for the casing for shielding the inner magnetic field. The two ends of the axis of rotation of the gyro are made flush with the surface of the spherical parts. It is also possible to provide corresponding devices, for instance, devices in the form of screw lockings in order to prevent the nuts serving to secure the axis of rotation of the gyro from becoming loose. In this case these devices may be arranged in such a manner as to lie inside the outer spherical surface of the gyro casing. Therefore the shape of the gyro casing is such that when the axis of rotation of the gyro is mounted and both spherical parts are secured together no projecting parts are present.

ADOLF BACH.

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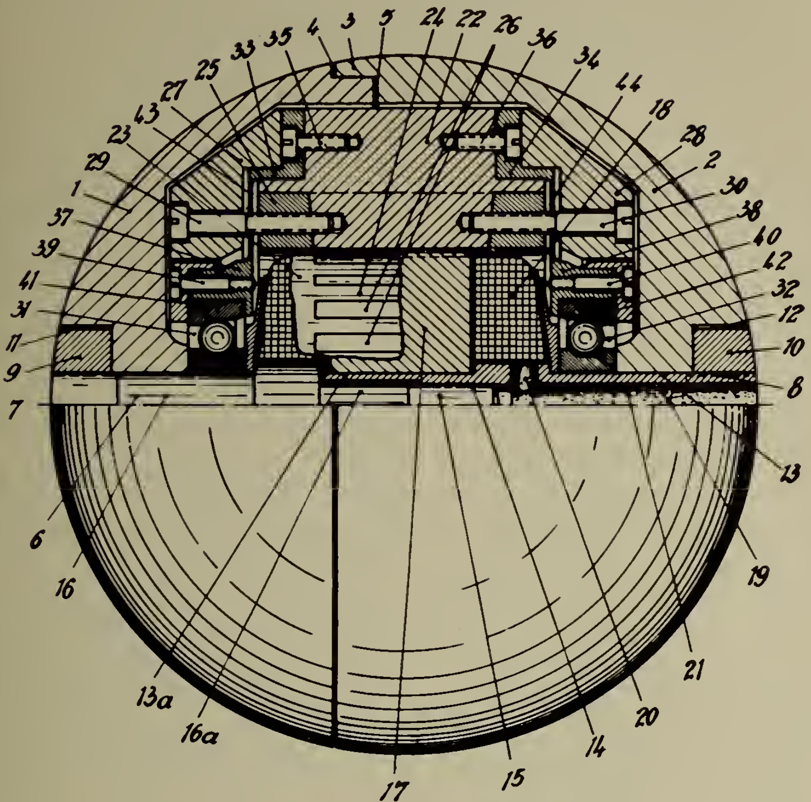

Adolf Bach, Inventor

By his Attorneys

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ALIEN PROPERTY CUSTODIAN

CAGE FOR CYLINDRICAL ROLLERS

Heinrich Rausch, Steyr-Oberdonau, Germany; vested in the Alien Property Custodian

Application filed May 8, 1941

The object of this invention is to provide a sheet metal cage for cylindrical rollers of roller bearings, formed by a sheet metal ring of substantially U-shaped section, especially characterised by the feature that the edges of the openings for the rollers in the web of the cage are pressed out in such a manner as to form cups, yielding both guides and respectively seats for the front faces and the cylindrical surfaces of the rollers, which cups at the same time provoke an effective stiffening of the cage. For retaining the rolls within the sheet metal cage the parallel edges of the vertical walls of the sheet metal ring are bent inward against each other between the rolls, so that the section of the sheet metal cage at these points between the rolls gets the form of a strongly bent C.

In the accompanying drawing the object of this invention is shown in some of the possible embodiments.

Figure 1 is a section through a roller bearing with cylindrical rollers with internal seat, the sheet metal cage being shown in the upper half of the illustration cut across through the centre of a roller and in the lower part the cage is cut between two of the rollers.

Fig. 2 is an end view partly in section of a portion of a sheet metal cage with the rollers assembled in it.

Fig. 3 is a detail in which a portion of the sheet metal cage is assumed to be spread out and where the part at the left of the dot-and-dash line shows the cage from below, at the right of this line from above.

Fig. 4 shows a section through a roller bearing with cylindrical rollers with external seat similar to Fig. 1, and here again the upper half of the illustration shows a cut across through the centre of a roller and the lower part is a section between two of the rollers.

Fig. 5 is an end view partly in section of a portion of a sheet metal cage according to Fig. 4, with the rollers assembled in it.

In Fig. 1 the internal race is designated by **1** and the external race by **2**. The sheet metal cage **3** is of U-shaped section, the side-members or walls are designated by **3***a*, the web has the reference **3***b*. The web **3***b* is located towards the side of the seat and has openings **4** stamped out for receiving the rollers, these openings being made so narrow and the edges of said openings being pressed out in a manner to form cups, that is to say that from the web **3***b* there are projecting guiding walls **3***b'* for the front faces **5***a* and seats **3***b''* for the cylindrical surfaces **5***b* of the rollers **5**. After the rollers **5** have been inserted into the cup-shaped openings **4**, the outer edges of the side-members or walls **3***a* of the sheet metal ring are bent inward against each other between the rolls, so that by these drawn in portions of the walls designated by **3***a'* the rollers are secured from falling out of the cage. Between the rollers the section of the sheet metal cage gets the form of a strongly bent **C**.

Owing to the guiding walls **3***b'* and seats **3***b''* pressed out of the web **3** at the side of the seat and farther owing to the drawn in portions **3***a'* of the side-members or walls **3***a* between the rollers **5**, the sheet metal cages made according to this method are remarkable for great rigidness.

In case it should be required to give the cages larger guiding surfaces for the rollers, the rims of the openings **4** may eventually be slit or incised to some extent at the webs **3***b*, especially in the corners, and the same might be done with the rims of the side walls between the rollers. In this manner there might be procured guiding flaps for the front faces **5***a* and the cylindrical surfaces **5***b* of the rollers.

Referring to Figs. 4 and 5, the outer race **2** is developed as a ring for external seat. Accordingly the sheet metal cage **3** is formed with the web **3***b* outwards and the side-members or walls **3***a* extending inwards.

HEINRICH RAUSCH.

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CAGE FOR CYLINDRICAL ROLLERS

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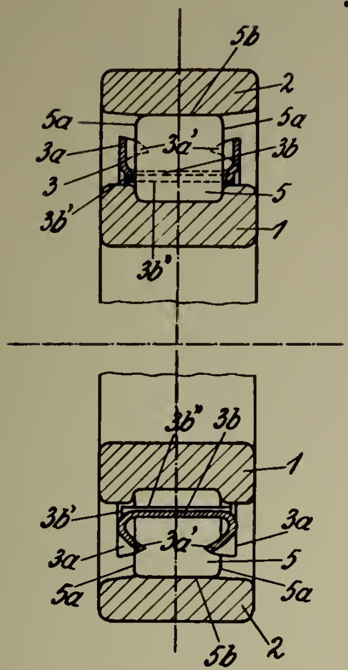
Fig. 1



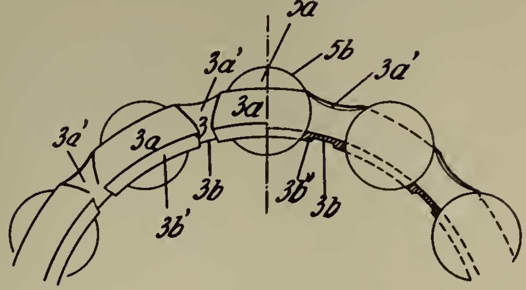


Fig. 2

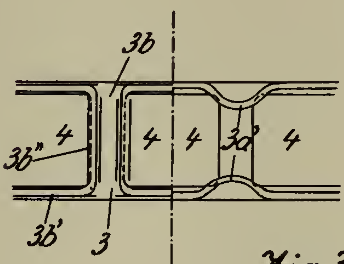
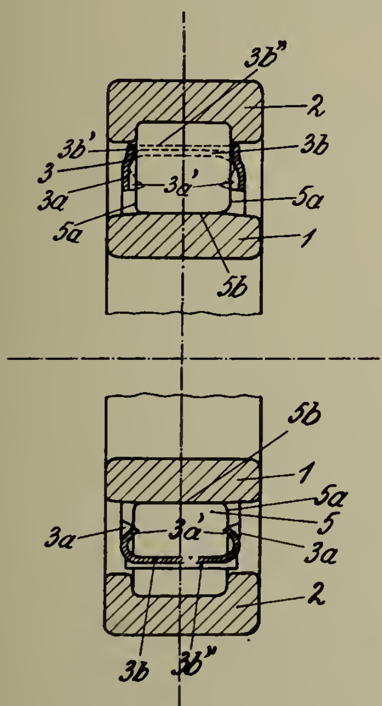


Fig. 3

Fig. 4



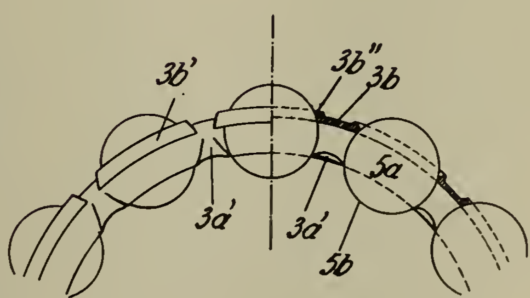


Fig. 5

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ALIEN PROPERTY CUSTODIAN

METHOD AND MEANS TO INCREASE DURATION OF THE CONTACT AND/OR THE SURFACE OF THE SAID CONTACT BETWEEN A VAPOROUS OR GASSY FLUID AND A LIQUID PARTICULARLY FOR THE PURPOSE OF DISTILLATION, ETC.

Giovanni Rossi, Milan, Italy; vested in the Alien Property Custodian

Application filed May 12, 1941

The subject-matter of this invention is a method and means for increasing duration of the contact and/or the surface of the said contact between a vaporous or gassy fluid and a liquid particularly for the purpose of distillation, rectification, and conduction of gas and vapours, degassing, evaporation, floating and the like and apparatuses incorporating the said means.

The method according to the invention of the type in which a vaporous or gassy mass is in the presence of a liquid for the purposes mentioned hereinbefore, is characterised by the fact that the vaporous or gassy fluid is compelled to divide up in the liquid in a large number of bubbles and these by coming into contact with solid surfaces for this purpose, come up along them above the liquid thereby using the adhesion and thrust effect of the underlying bubbles.

Performance of this method can take place in widely different ways and with widely different means of which a series is illustrated in the drawings annexed.

It is known that owing to molecular adhesion, liquids have a tendency to come up along the walls.

This tendency is notably accentuated when vapours or gases are bubbled but above all when this bubbling takes place between two walls or dividers and better still if they are corrugated round or the like and very near to each other.

In this last case and with equal terms for pressure, a breaking level of the bubbles can be obtained (boiling height) which is more than the normal height of the same phenomenon produced in known conditions.

The said dividers brought near to each other, have furthermore the characteristic of keeping the liquid still and hence of being able to absorb a larger load of vapours without giving rise to spray or rippling by this.

It is furthermore possible to gather the liquids together, which in some cases may be considered as exhausted or saturated. on the top of the aforesaid walls and separate them from the remaining liquids.

With particular reference to the distillation and rectification columns, the remark must be made that the yield of a column is the function of the contact surface between the liquid and the gas and of how long this contact lasts.

Practical realisation of these conditions in the present apparatuses is very far from the limit conditions mentioned hereinbefore, and besides this, it cannot be said that the present columns with their imperfect yield, represent at least a practical apparatus easy to adjust and start, and furthermore able to support work-points.

Rational application of the aforesaid principles in a distillation column, in which in every element is used at the same time, the surface and bubbling liquid and vapour analysis, allows a yield to be obtained, with an equal amount of vapour used, which is equal to the sum of the two systems and improvements to each of them in regard to the present bubbling and surface columns.

A column according to the aforesaid inventive ideas is therefore smaller than those known and costs less.

It furthermore has the advantage of nearly doing away completely with all the troubles attributed to the other columns and of having some new and useful features, such as a larger gas passage capacity without giving rise by this to mist, spray or rippling in the liquids, as well as the possibility of constructing types suitable to work with liquids which leave sediments and hence require to be shaken continuously, the possibility of starting operation of the column in a few minutes with great broadness in the adjustment of same, the possibility of working at higher pressures or lower depressions or temperatures than the present columns with bubbling, and hence the possibility and advantage of varying the height of the liquid in the single plates, the possibility and usefulness of a forced circulation of the liquids to exploit better the features of the column itself made up either of units over each other or beside and over each other, or the like, the possibility of obtaining excellent advantages in distilling under a high vacuum (molecular distillation), the possibility of separating the exhausted liquids, or those considered as such, from the sediments in every distillation unit, and finally the possibility of totally or partly transforming even the present bubbling columns without much expense being involved.

The annexed drawings, which are only given as examples to illustrate, without confining the range of the invention in any way, show different forms of performance of the invention, namely:

Fig. 1 is a part view in a lengthwise section of a distillation plate or unit for vertical columns.

Fig. 2 is the crosswise part section.

Fig. 3 is a part lengthwise section of a second variation of performance.

Fig. 4 shows in one part plan only the different forms and arrangements of lifting means and surfaces.

Figures 6 and 5 show in a section other varia-

tions of performance of the bubbling means with the individual dividers.

Fig. 7 is a section on a horizontal plan of Fig. 6.

Fig. 8 is another variation partly sectioned.

Fig. 9 is a horizontal section concerning Fig. 8.

Fig. 10 is like Fig. 9 and illustrates a performance variation.

Fig. 11 is a part elevation with parts in a section of another form of performance of the distillation plate.

Fig. 12 is the respective crosswise section.

Fig. 13 shows a different arrangement of the sectors.

Fig. 14 is a part lengthwise section of a variation in which the application of mechanical shaking means is provided for.

Fig. 15 is a part plan.

Fig. 16 shows another form in a lengthwise section with parts in view.

Fig. 17 is the crosswise section relating to Fig. 16.

Figures 18, 19 and 20 show particulars of a device apt to vary the liquid beater in the distillation plates.

Fig. 21 is a section according to the line x—x of Fig. 20.

Fig. 22 schematically shows two distilling units of a slanted column which have been obtained in accordance with this inventive teaching. With reference to Figures 1 and 2, each distilling unit calls for a set of bubbling means A consisting of pipes 50 bent to a capsized U. One end 51 of the foregoing pipes is suitably fixed to plate P so as to communicate with the lower cavity, whereas the pipe end 52 has lengthwise cuts or holes or the like and remains immersed in the liquid contained in the said plate.

The ends 52 are funnel widened, as shown by the drawing, and face each other at the bottom of plate P in such a way as to bubble the vapours in the liquid of the plate. The height of pipes 50 is greater than that of the liquid of plates P and can be of about 10–20 times the diameter of the pipes. This for the purposes already mentioned as well as to guarantee that the liquid contained in the plate cannot be sucked through the said pipes, if a lack of pressure equilibrium takes place in the distilling apparatus, which may be due to any cause.

Pipes 50 are arranged in such a way as to allow diaphragms D to be inserted, which are shaped and applied in any way to obtain efficient bubbling of the vapours in the liquid and the highest lift of the said liquid in the intervening spaces formed by the walls of the said diaphragms, as well as a further sub-division of the vapour bubbles in smaller sized bubbles.

In the illustrated case, the diaphragms D have means for collecting in the upper part, any residue liquids from broken bubbles, so that the said collected liquids can be suitably conveyed into circulation or taken away. Such collecting means consist advantageously of a duct 54 on top of the diaphragms A; these ducts are joined to each other in the required way to convey the collected liquid to the desired point.

Diaphragms D can be of the most suitable type and arranged in such a way that the plate liquid follows a forced course. It is not to be excluded that the said diaphragms are put in the plates in a slanting or end-up position and so on, in order to increase the duration and the surface of contact between the liquid and the gas. Fig. 4 shows different shapes of these diaphragms more or less corrugated or eventually combined with other diaphragms so as to make different intervening spaces between one set and the other of the bubbling means 50.

Eventually the diaphragms can have holes or side wings 55 or they can be knurled (Fig. 4), brought back, or obtained in any way.

The said diaphragms can likewise be combined with or replaced by metal straw and/or mesh, Brégeat's spirals, Xanching rings and so on. Fig. 3 shows a solution equivalent to that of the foregoing case, according to which the bubbling means A consist of a middle pipe 60 fixed to plate P of a suitable length and covered by hood 61 with ports 62 or holes on its mouth at a limited height.

In this way the vapours coming from the lower chamber go up in pipes 60 and come down in the intervening spaces 63 formed between them and the inside of the hoods 61 and by going through the ports 62, they bubble in the liquid and pass into the upper chamber. This arrangement allows a large number of the said bubbling units to be installed for each unit of surface of the plate, thereby the condition is accomplished of having nearly all the liquid undergo the action of the vapours or gases.

Bubbling means A are shown in the figures from 5 to 10, of the hood type having auxiliary or individual diaphragms D'. In the simplest case these consist of a pipe 65 (Fig. 5) provided with an opening 64 coaxial to hood 61 so as to form with this a limited size ring shaped intervening space 66. The vapours or gases throttled by the bubbling unit A, subdivide into very small bubbles which rise in the intervening space above the liquid. When they become larger they can be further subdivided by re-dividing units 67, 68 and 69.

Owing to their limited diameter and the molecular adhesion the gas bubbles do not break, and little by little as they go up, their speed is slackened owing to the guide and contact surfaces thereby increasing the duration of contact and the surface of this contact between the liquid and the vapour. The action of the individual diaphragms D' can be magnified by having in the intervening space 66, which in this case is larger than in the previous case, bodies or pipes with a star or polygonal section 67 (Figures 6 and 7) or with ripples 68 (Figures 8 and 9). In the last case diaphragm D' can be reduced to a corrugated sleeve 69 inserted on pipe 61, it can be eventually adapted to pipes 50 of the example illustrated in Figs. 1 and 2.

Figures 11 and 12 show another very advantageous form of realisation of a distillation plate P, where the fixing holes of the bubbling means A are done away with. These consist of tubes 70 ending with a funnelshaped part 71 or joined to an upper collector 72 fed in its turn by a conduit 73. In this case too, the diaphragms have collecting ducts 54 on the upper part. The diaphragms can possibly be of another type as illustrated in Figures 4 to 10 mentioned before. Application of the diaphragms illustrated in Fig. 13 is of particular importance, which calls for a set of elementary diaphragms beside each other with a middle sector 75 and another two side sectors 76 having the task of further sub-dividing the larger bubbles.

The corrugated sectors 76 are placed in such a way that they are raised from the bottom of plate P to a certain height. This is to bring about that when the gas or vapour bubbles increase in their volume in their movement upwards, they

are fractured by the corrugated sectors 76, so as to produce other bubbles with a smaller diameter for the purposes given. The case cannot be excluded that the intervening space made between the bubbling units A, can receive more sets of diaphragms D as described hereinbefore. When thick liquids are being dealt with or those having materials in suspension it is generally expedient to keep on shaking the liquid. If it is to be shaken mechanically, this can easily be done with the arrangement illustrated in Figures 14, 15 and 16.

The bubbling means A are fixed to collector 72 so that they are raised from the bottom of plates P to the required height to leave a place for the agitating vanes 80 operated by a shaft 81 provided with a gland or water-tight means 82.

Collector 72 is supported by stand pipes 73 fixed towards the periphery of plates P.

Fig. 16 shows a variation of the shape according to Figures 14 and 15 and Figures 11 and 12 too, where the bubbling means A consist of a canted cavity 85 fixed at a suitable height to pipes 86, these being fixed to plate P. The edge of the said hood which is dipped in the liquid, has cuts 87 or holes, or the like capable of finely fractionating the gaseous fluid.

In the form of Fig. 16, the ducts 88 can be advantageously made at the top of the hoods 85.

According to the materials dealt with it is better to vary the level of the liquid on each plate P without interrupting the run of the column. This can be done with one of the devices shown by Figures 18 to 21. In the case of Figure 18, the discharge or overflow pipe 90 fixed to plate P and fishing in the liquid of the following plate, is combined with a telescope pipe 91 entrusted by the auxiliary of rods or chains 92, to an arm 93.

An operating shaft 94 is in one with the arm 93 and by going through a gland or the like 95, it juts out at the outside of the distillation column. By operating the said shaft, pipe 91 is put more or less in pipe 90, so that the liquid beater is varied during the operation. Shafts 94 of the different plates making up the column are kinematically coupled between each other so as to obtain at the same time with one manoeuvre only the same level variation in all the plates.

The variation according to Fig. 19 provides that the telescope pipes 91 are supported by a vertical rod 96 going through all the plates P and hence inside the column. The passage for rod 96 in correspondence with plates P having an overflow pipe 90 in a position opposite to that illustrated, is obtained by means of a hydraulic joint consisting of a bell 97 in one with the said rod, which dips in the liquid and fits in a pipe 98 higher than the highest level taken by the liquid in plates P to thereby obtain the required tightness. Coupling takes place in the same way for the other telescope pipes opposite to those now taken into consideration; the rods 96 after passing through the two glands, jut out at the outside for the drive.

The level of the liquid can also be varied with the device illustrated by Figures 20 and 21 where the overflow pipe 90 is right angle bent and receives a hollow turning body 99 ending with a vertical mouth 100. The manoeuvre of shaft 94 in one with the hollow body 99 angularly moves mouth 100 and dips it more or less in the liquid varying consequently the level of this liquid. The telescope pipe can possibly have a thread to adjust the level. Although the technical and inventive ideas described hereinbefore refer to columns of distillation and/or rectification of the vertical type, they can likewise be made an accomplished fact in horizontal or slanting columns. A scheme of this last type is illustrated by Fig. 22, where the bubbling units A consist of tubes turned over to the division sectors S. The bubbling units are combined with diaphragms D of the previously described and illustrated type. In the case of horizontal columns the circulation of the liquid will be forced by suitable means (pumps, injectors and the like) with an individual drive for each plate, so as to have the column operate in pressure or depression.

The fundamental technical rule can of course be applied advantageously to the case of production of vapour in each single plate with the help of heating power. In this case the bubbling units are done away with as the presence of units for raising contact and surface are sufficient in the form of dividers, rods, pipes and the like. The boiling height and therefore duration of the bubbles can be favoured by the presence of suitable chemical agents. For instance, in the case of a neutral liquid (an alcoholic solution), this chemical agent can be sodium hydrate in a very small quantity.

Fractioning of the vapours in accordance with the foregoing, takes place in the beginning as in the ordinary bubbling columns, with the advantage over the latter however of such a subdivision of the vapours as to obtain extremely small and regular bubbles spread nearly all over the surface of the plate. They are sent out preferably horizontally into the liquid, through thin cuts or little holes, and on the bottom of the plate if possible.

While this throttling of the vapours increases the outlet speed of same, it makes it impossible for continual vapour jets to form, as they are immediately fractioned in the liquid in very small bubbles which go away from the source with a horizontal run before arriving at the surface of the liquid.

During this run the bubbles increase in size at the surface of the liquid when going up and when they come into contact with the units of sustenance and of raising (which have the further aim of limiting their association and eventually of fractioning those which are too large), and in virtue of the molecular adhesion, the said bubbles do not break but slacken ascensional speed thereby increasing the duration and the exchange surface between the liquid and the vapours.

In suitable running conditions the said bubbles reach the top of the raising unit, and without supports their breakage takes place there, which is helped by the increase in size of the bubbles and the impoverishment of the liquid given to the support walls, having made their thickness extremely fine, and such as to not cause spray or atomisation of the liquid when they break, because the vapours that formed them were nearly at the same tension as those of the upper part of the distilling unit.

As mentioned before, it might be interesting to collect the liquids left over from the breaking of the bubbles on the top of the aforesaid units to convey them outside of the distilling unit, since in some cases, the said liquids, if they have rationally undergone the aforesaid treatment, can be considered as exhausted; hence considerably increasing the working capacity of the following

distilling units in this way and consequently reducing the consumption of steam.

If they are not collected as above, these liquids can go down again along the sustenance units, or fall outside of the said units thereby giving rise to a real vertical circulation and a new factor of surface analysis.

The liquid-vapour analysis can therefore be pushed to extreme possibilities thereby justifying the exceptional yield of a column realised in accordance with the aforesaid system.

The particulars of performance and execution in practice, as well as the uses, can vary in any way without leaving the range of the invention by this, or the protection of the industrial patent.

GIOVANNI ROSSI.

PUBLISHED

JUNE 1, 1943.

BY A. P. C.

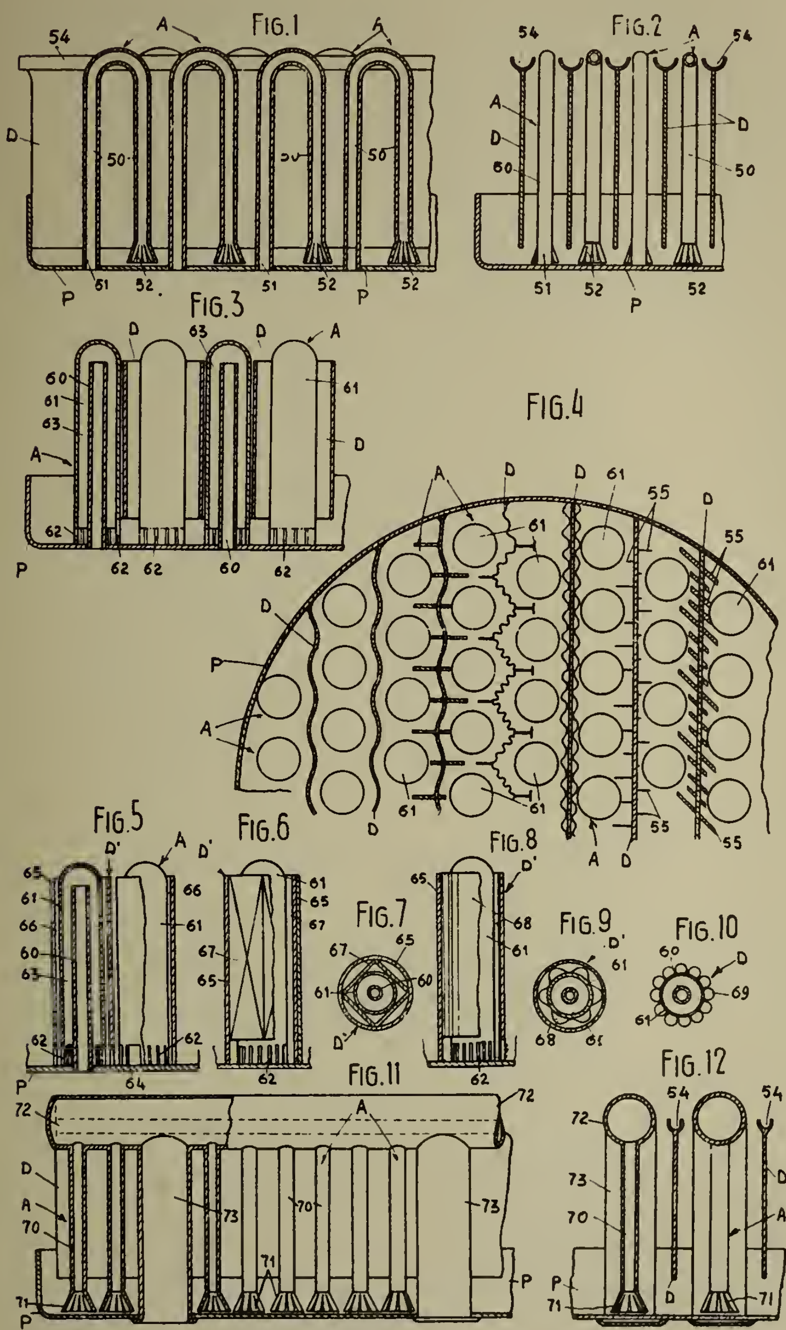
G. ROSSI

METHOD AND MEANS TO INCREASE DURATION OF THE CONTACT AND/OR THE SURFACE OF THE SAID CONTACT BETWEEN A VAPOROUS OR GASSY FLUID AND A LIQUID PARTICULARLY FOR THE PURPOSE OF DISTILLATION, ETC

Filed May 12, 1941

Serial No. 393,122

2 Sheets-Sheet 1



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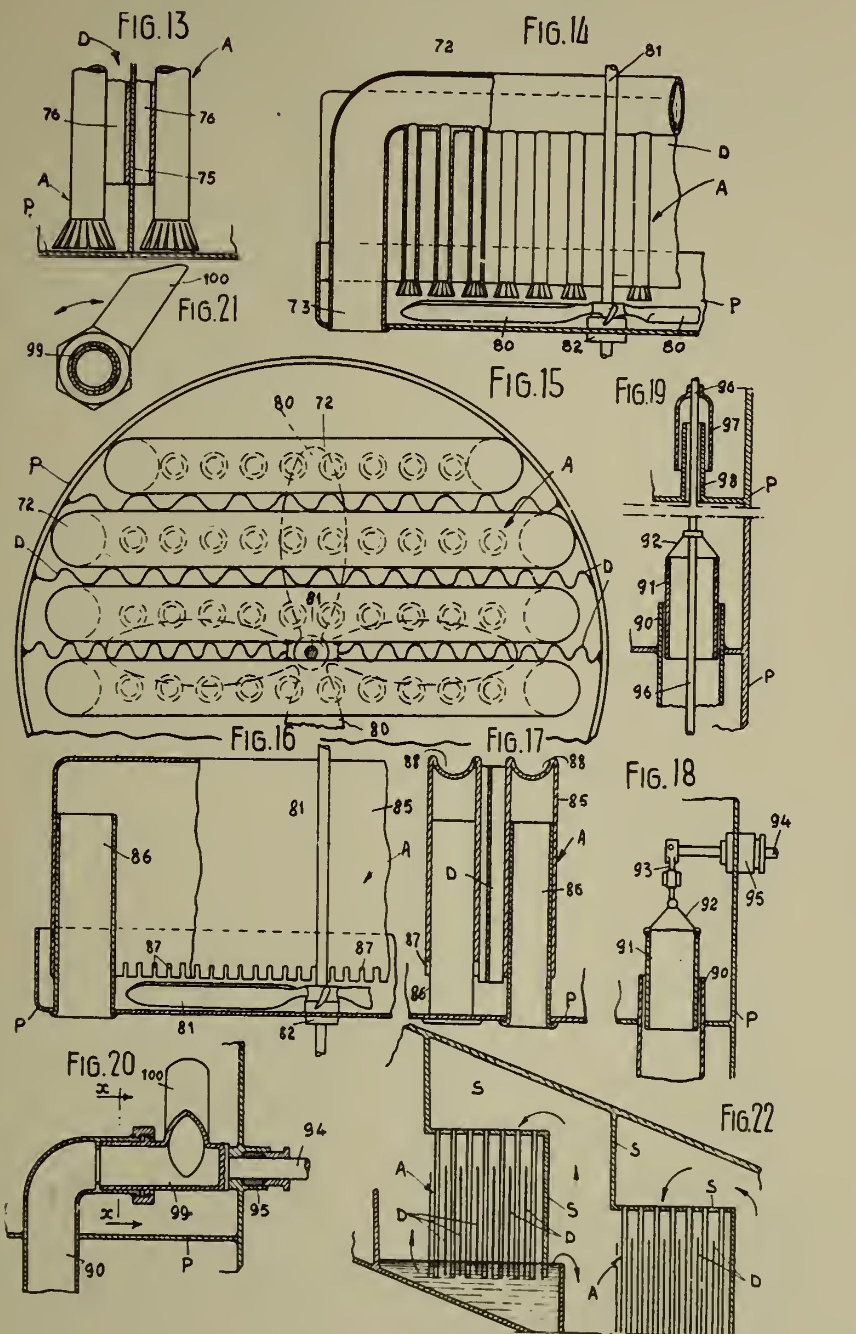

Published June 1, 1943

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ALIEN PROPERTY CUSTODIAN

COMPOSITION AND METHOD FOR CONTROLLING NOXIOUS ORGANISMS

Marius Frits Henri Betting, Haarlem, Netherlands; vested in the Alien Property Custodian

No Drawing. Application filed May 13, 1941

This invention relates to a composition and a method for controlling organisms, particularly micro-organisms, being noxious or injurious to the plant or animal body.

In its broad scope the object of my invention is a composition and a method for controlling such noxious organisms occurring externally as well as internally in the plant or animal body, especially for combating micro-organisms, more in particular viruses.

More particularly an object of my invention is a composition for combating organisms being noxious to the plant body and parts thereof, such as insects, larva and the like and especially micro-organisms such as fungi, bacteria and more particularly viruses.

Another object of my invention is a composition and a method for protecting plants and parts of plants, especially foliages, bulbs, tubers, rhizomes and the like from the attack of noxious micro-organisms, such as fungi, bacteria and more particularly viruses.

Another object of my invention is a composition for remedying plants suffering from the attack of noxious organisms, for their protection from renewed attack and for stimulating their growth and recovery.

Another particular object of my invention is a composition and a method for protecting and/or remedying bulbs, tubers, rhizomes and the like from the attack of viruses.

Another object of my invention is the purification of the soil from noxious fungi, bacteria and particularly viruses.

Another particular object of my invention is the remedying of cattle attacked by foot-and-mouth disease and preventing the spreading of this disease.

The composition according to my invention displaces its action in the plant body as well as in the surrounding soil and atmosphere. I attain this purpose by using volatile active substances of such a nature and in such a form that they are well absorbed in plants or parts of plants and/or in the soil, in which they slowly evaporate and therefore show a good depôt-action. Though I do not wish to be bound to any theory it may be said that the surprising results obtained with my compositions are due to the fact that all internal parts of plants are reached, since the volatile active agents are also present in the air in and around the plants, particularly also in the intercellular spaces.

My composition comprises in dispersed condition in an aqueous medium one or more volatile alicyclic (i. e. aliphatic carbocyclic) compounds, particularly one or more terpenes or terpene derivatives. In most cases, however, I prefer to use a composition in which at least one volatile oxygen containing alicyclic compound is present. As examples of kinds of alicyclic compounds which I may use the following compounds and mixtures thereof may be mentioned: terpineol, pinenes, phellandrenes, camphene, azulenes, sesquiterpenes, cineole, umbelliferone derivatives, bisabolene, aromadendral, piperitone, terpines, terpinols, pinol, etc. I have found that in many cases particularly mixtures containing cineole are very active and suitable for my purpose. I have further found that in many cases a composition containing moreover a natural or synthetic resin, such as colophony and particularly aloe resin, is advantageous, whereas for special purposes a composition containing phenol and/or its homologues yields particularly good results. As such a phenolic constituent I preferably use phenol, cresol and creosol (hydroxy-1 methoxy-2 methyl-4 benzene) or mixtures thereof.

According to my invention I prefer to use mixtures of alicyclic compounds which to some extent correspond to or resemble such mixtures occurring in nature. Therefore instead of starting from the alicyclic compounds themselves I may compose my compositions with the aid of crude essential oils containing such compounds. I have found that eucalyptus oil, cajeput oil, turpentine oil, lemon oil, camomile oil and the like are particularly suitable for most cases. My composition comprises further preferably an emulsifying agent, e. g. a soap of an alkali metal. The mixture of the alicyclic compounds or of the essential oils and, if desired, a resin and/or one or more phenolic compounds can be dispersed in water as such, but I prefer to dissolve it first in an organic solvent, preferably an alcohol. As such a solvent—commercial spiritus is very suitable.

My composition has appeared to be very suitable for controlling viruses, bacteria, fungi and also insects, larva and the like. I have obtained surprising results in combating viruses in bulb-plants, e. g. tulip-virus, hyacinth-virus, daffodil- and narcissus-virus, iris-virus, crocus-virus, lily-virus, etc. and also of viruses in seed-plants, e. g. bean-virus, onion-virus and tomato-virus. I also have combated in an excellent manner e. g. bacteria causing rotting, such as the bacteria occurring on cyclamens, gladioluses, carnations, etc. As examples of fungi which have been successfully combated with my compositions kinds of Pythium and Verticillium fungi occurring on dahlias and cyclamens may be mentioned and as examples of insects and larva the chrysanthemum fly and the larva of the Scaria fly.

The results which I have obtained in many experiments, also on a large scale, are surprising, since besides a vigorous combating of the injurious organisms also a recovery and remedying of the attacked plants or their parts occur. For instance colours of foliage and flowers having been broken by viruses are closed and the normal growth and the normal character are restored.

Moreover these favourable results are rapidly obtained and they are permanent. Still further advantages of my compositions are that they are easily absorbed by the plants and do not show any noxious or injurious action. The slow evaporation of the composition causes a permanent and vigorous action and the treatment can be repeated without danger for the plants. The washing out of the compositions is limited by their absorption in the plants and the presence of a resin counteracts the deposition of dew on the parts of the plants above the soil, while it further protects wounds and openings (e. g. stomata in the leaves) against the penetration of noxious organisms. Moreover, however, the compositions containing resin surprisingly appear to stimulate the growth and the development of the plants, particularly the development of the root system and the germination of the seeds, which has a great importance for the normalisation of attacked plants, since the plant now can rapidly recover. From experiments with suckers of e. g. carnations, dahlias and chrysanthemums it appeared that the action of the resin containing compositions according to my invention in many cases is even better than that of phytohormone products, such as Auxan, Hortomone A, Root Gro and Roche 202.

The treatment with my compositions can be executed e. g. by sprinkling or spraying and/or immersion. Plants, foliages and the like may be treated by spraying the composition on the plants, etc. Parts of plants, such as bulbs, tubers, rhizomes and the like may be treated by immersing them during some time in the composition, e. g. in closed spaces. Plants and parts of plants in the soil can be sprayed and sprinkled with the compositions, while the soil itself can be purified, e. g. for the combatment of soil viruses, by moistening the soil with the composition and subsequent covering of the moistened soil. In the case of bulbs, tubers, rhizomes and the like the results by treatment before the planting are much better than by treatment after the planting, since in the first case the active compounds are brought into the soil before the planting and the evaporation is limited, whereby by a slow evaporation in the soil and in the atmosphere a long purifying action on the soil and the plant is obtained. Spraying with or immersion in my compositions is also a good remedy by small wounds, e. g. caused by breaking of the roots by replanting, cracking of bulbs, etc., since it entirely prevents attack by penetrating viruses. The treatment with my compositions is particularly suitable for an efficient disinfection of the soil and the whole space in hothouses in which usually very much sources of infection are present. In contradistinction with the known disinfection with steam, methanol, etc. the treatment with my composition can even be executed during the cultivation of the plants.

In order to elucidate further my invention the following prescriptions are given, which, however, are only intended as mere examples and do not limit my invention in any manner.

Example I

A mixture of

Crude turpentine oil	cubic centimeters	100
Cajeput oil	do	100
Colophony	grams	5
Potassium linolate	do	5
Crude cresol	do	5

is dissolved in 500 cm^3 of commercial spiritus. By mixing 100 cm^3 of this solution with 10–15 l of water an emulsion is obtained which is particularly suitable for the treatment by immersion of bulbs, tubers, rhizomes and the like being attacked by viruses. The plants obtained from thus treated bulbs, etc. show a striking improvement, closing of the broken colours of the flowers and the leaves and normal growth and development.

Example II

By spraying the emulsion according to Example I on gladioluses, carnations and cyclamens being attacked by bacteria, a good recovery is obtained and the growth and development of the root system are stimulated without any detrimental effect to the leaves or the flowers.

Example III

In 10–15 l of water is emulsified 40 cm^3 of a mixture of 60 cm^3 of turpentine oil, 60 cm^3 of eucalyptus oil, 30 g of gum-arabic and 15 cm^3 of creosol. By immersion of tulip bulbs in this emulsion a striking recovery of the tulip plants is obtained. Rembrandt-Copland tulips showing a flower pattern being broken to a very great extent and also the often occurring breaking in the leaves, yield beautiful green plants, the condition and the growth being 30–50% better and higher, the breaking in the leaves disappears and the colours of the flower pattern are deepened and closed.

By large experiments with tulips by treatment of the plants before digging the bulbs at different moments and by treatment of the dug up bulbs at different moments it has appeared that the results are the better the sooner the treatment is executed. Minister Hull (broken Bartigon), Rembrandt-Copland, Rembrandt-Solida, Rembrandt Moor, Rembrandt Violla, etc. and other kinds of tulips by early treatment show a complete or substantially complete closing of the colours; e. g. broken Minister Hull becomes completely closed red Bartigon.

Example IV

For the treatment of hyacinths an emulsion is prepared by dispersing in 15 l of water 100 cm^3 of a mixture of

Crude turpentine oil	cubic centimeters	120
Cajeput oil	do	60
Creosol	do	20
Potassium soap	grams	20
Commercial spiritus	cubic centimeters	400

By treating with this emulsion seriously attacked bulbs of gray Yellow-hammers, Dr. Lieber-hyacinths, etc. before the planting a recovery of the growth and the green leaves and also a normal flower are obtained.

Example V

The emulsion according to Example IV is also particularly suitable for the treatment of daffodils and narcissuses. By immersion of the bulb of Rembrandt narcissuses 50% of which were gray on the field, a complete normalisation is obtained and even traces of attack disappear. The spraying of narcissuses plants on the fields, e. g. Golden Harvest, King Alfred, etc. already yield considerable results, since the growth is restored, leaf tissue being attacked by virus becomes still active, the early dying does no longer occur and the condition and growth of the plants are 100% better.

Example VI

Iris plants appear to be very sensitive to a treatment of the bulbs and plants with an emulsion according to the preceding examples, so that a complete normalisation of the colour breaking in the flowers and the leaves of e. g. Wegdwood Iris plants, English Iris plants, etc. is easily obtained.

Example VII

With an emulsion obtained by adding an aqueous amylum emulsifying agent to a mixture of 50 g of turpentine oil, 25 g of cajeput oil and 10 g of colophony to a total volume of 100 cm³ and emulsifying 20 cm³ of this mixture in 10 l of water, excellent results can be obtained with horticultural plants. Kinds of onions which are attacked by viruses and consequently show bad plants and stop the growth and die, show by spraying already after 1 week a visible improvement and after 2 weeks the growth is clearly restored, forming of new leaves occurs, etc. Also kinds of French beans, potatoes and tomatoes show by spraying with this composition a soon and permanent improvement.

Example VIII

For the treatment of e. g. potatoes a mixture of

Crude turpentine oil	cubic centimeters	200
Cajeput oil	do	50
Alcali soap	grams	40
Cresol	do	40
Commercial spiritus	cubic centimeters	800

is prepared. For the treatment of the seed-material by immersion 100 cm³ of this mixture are dispersed in 20 l of water and for the spraying of the plants in the field an emulsion of 100 cm³ of the mixture in 10 l of water is prepared.

Example IX

For combating rotting and disease bacteria 100 cm³ of a mixture of

Crude turpentine oil	cubic centimeters	100
Eucalyptus oil	do	20
Creosol	do	25
Alcali soap	grams	25
Commercial spiritus	cubic centimeters	400

are emulsified in 10 l of water. With this emulsion e. g. the disease of gladioluses caused by Bacterium marginatum can be treated. Spraying of this emulsion on potato-plants on the field prevents the disease caused by Bacterium phytophtorum.

By adding a resin, e. g. colophony to this emulsion a composition is obtained with which rotting bacteria in hothouses can be combated, e. g. Bacterium cyclami, which causes rotting in the roots of cyclamen.

Particularly striking results are obtained in hothouses with carnations being attacked by rotting of the stem. By experiments in a hothouse with 200 suckers of sensitive kinds no or at most 1–2 minus cases were obtained. Attacked suckers the stem of which was already brown and torn, recover and grow further well.

By repeated spraying also a complete annihilation of the sources of e. g. Bacterium pseudomonas tumef. in dahlia plants is obtained.

Example X

For combating fungi, e. g. mildew of roses, Fusarium fungi on summer asters, etc., 10 cm³ of a mixture of

Crude turpentine oil	cubic centimeters	50
Cajeput oil	do	50
Alcali soap	grams	20
Water	cubic centimeters	60

is emulsified in 5 l of water. If desired, 20 g of colloidal sulphur (vomasol) may be added.

Example XI

A very vigorous composition for combating fungi is obtained by emulsifying in 10 l water 100 cm³ of a mixture of

Crude turpentine oil	cubic centimeters	100
Eucalyptus oil	do	50
Colophony	grams	20
Alcali soap	do	20
Commercial spiritus	cubic centimeters	310

With this emulsion particularly the winter fungus of dahlies (Verticilium Alboratum) can be successfully combated and the attack of Pythium debar. and Rhizoctonia sol. can be prevented.

By using this emulsion for combating fungi on begonias and fern plants, e. g. Myxomycetus and Thielavia basicola, very good results are obtained. Also for combating spores of fungi in seeds and in the cultivation soil for bulb plants (such as kinds of Rhizoctonia and Sclerotium) the emulsion according to this example is very suitable.

Example XII

For combating the larva of the scaria fly and such larva the young seed plants of ferns are sprayed with an emulsion prepared by dispersing in 5 l of water 60 cm³ of a mixture of

Crude turpentine oil	cubic centimeters	100
Eucalyptus oil	do	100
Aloe resin	grams	50
Commercial spiritus	cubic centimeters	350

This emulsion kills also e. g. caterpillars and the larva of the chrysanthemum fly in the leaf tissue.

Example XIII

By experiments relating to controlling animal viruses I have obtained considerable results in the case of foot-and-mouth disease. Thereby in two manners confirmation of the fact has been obtained that a complete combating can only be obtained when the exact origin of the virus is found locally and the treatment is soon executed. In the period in which the disease shows itself treatment of the plants on the land in order to prevent spreading of the virus as well as treatment of the wounds of the attacked animals have to be executed. Two emulsions are prepared, viz.:

A

Crude turpentine oil	cubic centimeters	50
Eucalyptus oil	do	50
Aqueous protein emulsifying agent (cont. 2 beaten up eggs)	do	200

B

Crude turpentine oil	cubic centimeters	100
Eucalyptus oil	do	50
Alcali soap	grams	25
Creosol	cubic centimeters	25
Commercial spiritus	do	300

The attack in the mouth is treated by rinsing with emulsion A, whereby by immediate treatment by the first attack remedying occurs. In case of stronger attack, however, sometimes by a

longer treatment still a visible improvement, viz. diminishing of the blisters, is obtained. The attack of the hoofs and the meadows are treated by spraying with emulsion B. The wounds recover by repeated spraying and the spreading of the disease in the infected country is prevented by treating the infected places, the animals, the plants and the material also with this emulsion.

Various changes may be made in the details disclosed in the foregoing specification without departing from the invention or sacrificing the advantages thereof.

MARIUS FRITS HENRI BETTING.

ALIEN PROPERTY CUSTODIAN

METHOD FOR THE PRODUCTION OF COMPOUND CAST BEARING BRASSES BY MEANS OF THE PLUNGING CASTING PROCESS

Bernward Garre, Wiesbaden/Biebrich, Germany; vested in the Alien Property Custodian

No Drawing. Application filed May 17, 1941

Compound cast bearing brasses with supporting brass of steel and lining of lead bronze (Cu+Sn+Pb), the special advantages of which consists therein, that compared with white metal or Babbitt-metal bearings they possess quite considerably higher durability, are produced according to different methods with employment of sand-molds or chills. It is also known, to use herefore centrifugal- or dipping casting methods. According to all these methods a cooling of the compound cast piece is required at the termination of the casting proceeding, which eventually can be accurately regulated, for instance by ring shaped sprinklers.

It has also been proposed, to melt and even to cast the lead-bronze under exclusion of air and thereby that the whole crucible with the melting material is heated in an airtight chamber filled with a neutral gas atmosphere and to also carry through the casting within this chamber. This method is, however, comparatively complicated and does also not entirely prevent the absorption of gas, as also non-oxydising gases, such as hydrogen, are taken up by the molten mass of lead-bronze.

It is also usual to stir molten masses with rods of graphite or other material, in order to thus remove the gases.

It has further been proposed, to remove the impurities which might settle on the inner side of the supporting brass of steel by submitting the brass filled with lead-bronze and covering salt to a centrifuging movement, whereby owing to the centrifugal force the heavy lead-bronze displaces the impurities on the steel brass. The desired effect does, however, not take place completely as covering salt and lead-bronze partly get mixed the one with the other, so that a real separation of these materials does not occur. Owing to this fact the lead-bronze bearings produced in this manner are not suited for especially high stressed purposes, such as construction of motors for air craft.

Compared herewith, the present invention consists in that, with employment of the dipping casting process known as such, the method is conducted so that in a simple manner any impurity and gas-absorption is practically avoided.

This is attained thereby, that the molten lead-bronze is covered with such a thick layer of liquid salt, that the supporting brass serving as dipping vessel and filled with lead-bronze is, prior to the emerging, freed from the excess of lead-bronze by tilting within the salt cover and filled with liquid salt, whereas, in spite of the emerging, a completely continuous salt cover is ensured as well in the lead-bronze of the crucible as also in the lead-bronze of the scooping vessel. By suitable construction of the dipping vessel there is further ensured, that with a correspondingly shaped rod any point of the dipping vessel can be easily and thoroughly rubbed during the heating in salt and in lead-bronze.

The proceeding is, for instance, as follows:

An iron chill, which at the lower portion is tightly closed to form a dipping vessel, this being possible, for instance, by welding-on a sheet metal plate, by pressing-in a sheet metal plate or by working from the full or by other methods known as such, and which is equipped with a handle for gripping by the hands, is first dipped into the molten salt.

After the chill has been heated in the salt bath in known manner to the temperature of the salt of about 900 to 1000° C and by rubbing or the like with a rod of heat-proof material any impurities have been removed from the inner side of the dipping vessel, the dipping vessel filled with salt is brought into a molten mass of lead-bronze, which is covered with salt. With the aid of a heat-proof rod any impurities are again removed from the inner wall of the dipping vessel. The dipping vessel, which is now filled with the heavy lead-bronze, is taken out of the crucible in such a manner that the continuity of the salt layer on the lead-bronze of the dipping vessel and of the crucible is not destroyed. This is attained thereby that some of the lead-bronze by tilting the vessel is poured out of the vessel from above the molten lead-bronze, but from below the salt layer which covers the lead-bronze in the crucible, so that the salt replaces instantaneously this poured out lead-bronze. Only then the dipping vessel is taken out of the crucible and cooled.

In the method above described the dipping vessel of iron must be left in the molten mass of lead-bronze until heating of the vessel and a certain diffusion of molten mass and iron of the dipping vessel has occurred. With this object in view, the individual dipping vessel must remain at least a few minutes in the molten mass of lead-bronze. The molten mass of lead-bronze in the crucible takes up iron from the outer walls of the dipping vessels, whereby the molten mass is continually enriched in iron in the course of time. Also the molten mass inside the dipping vessel is continually enriched in iron during the time it remains in this dipping vessel. As already stated above, it is possible to effect part of the

heating of the dipping vessel by dipping the same into molten salt prior to the dipping into the molten lead-bronze. As, however, iron contents of more than 0.5% are already prejudicial and such above 1% extremely strongly attack the crank shafts, the dipping vessel, according to a development of the invention, may be heated in the molten salt to above the temperature which corresponds to that of the molten lead-bronze. The dipping vessel is then dipped into the molten lead-bronze by the shortest way and left in the same only until the molten salt has been displaced and the dipping vessel has just filled with lead-bronze. The space between the molten salt and the crucible can be made so short, by placing the two crucibles directly the one at the side of the other, that only a very insignificant drop of temperature occurs.

If up to the present only dipping vessels have been mentioned which are shaped like rotary bodies, the invention is not at all restricted thereto. In order to save metal for casting this can be applied onto bendable sheet metal plates of steel. In the sense of the present invention high quality compound cast bearings can be produced thereby, that box-shaped dipping vessels open at the upper end and consisting of two or more sheet metal plates mounted the one at the side of the other at a certain distance in a frame or vessel are first heated in a liquid salt bath and cleaned and then filled with liquid lead-bronze, thus displacing the salt, so that a small portion of the salt remains as covering layer on the dipping vessel. As already stated above, it can further be attained by rubbing with a rod on the inner surface of the dipping vessel, that slight impurities or gas bulbs, which might have settled on the inner wall, can be mechanically removed.

Up to the present it has only been stated that bearings are to be used which are cast on one side. If in a similar manner bearings cast on both sides are to be produced thereby that, for reasons of solidity, a thick iron wall is placed around the dipping vessel at a certain distance from the same, the lead-bronze does not adhere solidly on the outer surface of the dipping vessel, the binding is incomplete and the lead-bronze in the interval shows cracks. The lead-bronze adheres only incompletely on the wall laid around the dipping vessel. This defect cannot be overcome if, for instance, the inner side of the jacket is coated with layers which counter-act to the combination with liquid lead-bronze, for instance strong tindering.

Surprisingly a good binding of the outer wall of the dipping vessel can be produced if this outer wall is made of thin-walled sheet iron plate, according to a further development of the invention, and so that this sheet metal plate just withstands the pressure of the liquid lead-bronze, but can be curved inwards in accordance with the shrinking of the metal. In consideration of these conditions a perfect binding is obtained on the outer wall of the dipping vessel; the lead-bronze in the intermediate zone is dense and free from cracks. In a bearing brass with a welded-on bottom at 100 mm diameter and 70 mm height one has worked for instance with a wall thickness of the dipping vessel of 10 mm. The enclosing sheet metal wall was placed around the dipping vessel at a distance of 20 mm. If then the thickness of this wall was 3 mm, a binding on the outer wall of the dipping vessel had not taken place completely. The lead-bronze in the interval was cracked. If instead of the iron jacket 3 mm thick an iron plate only 0.5 mm thick was used, the bronze had well bound on the outer side of the dipping vessel. The surrounding thin sheet metal plate had been curved inwardly; the intermediate layer of lead-bronze was sound.

The real thickness of the sheet metal jacket is absolutely limited. The sheet metal must, on the one hand, be so thick that it withstands the pressure, of the molten lead-bronze, and, on the other hand, so thin that at the solidifying an alteration of shape in inward direction occurs. The thickness of the outer wall limited by these conditions depends evidently on the size of the dipping vessel, especially on the quantity of the molten mass of lead-bronze, which is between the outer wall and the steel lump to be cast. The relation of lead-bronze in kg to the thickness of the sheet metal plate in mm amounts approximately to 1:0.2.

Up to the present the manufacturing methods of bearings were represented only in relation to the heating or casting process. Such dipping vessels according to the invention filled with liquid lead-bronze and covering salt are then for cooling placed, for instance, into a ring-shaped sprinkler, but not brought to complete cooling to room temperature. The cooling by water is stopped already when on the inner surface of the vessel's red-heat temperature (700 to 800° C) exists on an extent of about one quarter of the diameter of the bearing.

If the dipping vessels are cooled in water from the casting temperature down to the room temperature, the steel cup directly exposed to the action of the water is much more rapidly cooled than the lead-bronze in the steel vessel. The heat expansion coefficients of the two metals or alloys are further very different, so that great tensions exist in the completely cooled vessels. Whilst therefore by the sudden cooling down to room temperature strong bulgings occur, these disagreeable properties can be avoided thereby, that the cooling from red heat temperature of the bearing core to room temperature is carried out without water cooling.

BERNWARD GARRE.

Published June 1, 1943

Serial No. 394,370

ALIEN PROPERTY CUSTODIAN

PRODUCING THREAD

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No Drawing. Application filed May 20, 1941

The present invention relates to a method of producing threads having a refined upper surface.

As is known rolled threads, i. e. threads produced by a chipless formation, have a series of properties which render their value higher than that of threads produced in accordance with other methods. So for instance the accuracy to gage is more exact and the surface finish also is better. Moreover, due to the metallurgical change the thread is capable of withstanding a higher repetition of stress.

Furthermore, it is well known that various surface coatings, surface treatments and surface refinings, for instance by chromium plating, phosphating, siliconizing, nitrating a. s. o impart properties of high value to the thread, for instance high hardness, high resistance to wear, rust protection, changed electric conductivity and electric isolation respectively, increased fatigue strength a. s. o.

If in connection with the manufacture of threads both methods are to be used conjointly, hitherto this was effected in first rolling the thread and afterwards applying the refining method. With an additional application of the surface refining method, however, the favorable influences of rolling the thread are partially or totally lost again. The surface finish becomes worse as well as the accuracy to gage. If the surface refining methods require the application of heat, then also the favorable metallurgical properties effecting an increased fatigue strength are lost totally or partially.

The advantages of conjointly applying the rolling of the thread as well as of the refining of the surface are obtained in accordance with the invention by first applying to a blank prepared to about the diameter of rolling a surface refining, for instance by chromium plating, phosphating, siliconizing, nitrating a. s. o. and then rolling the thread. The diameter of rolling of the prepared blank depends on the thickness of the refining layer to be applied.

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CARL NEUMANN.

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ALIEN PROPERTY CUSTODIAN

COMBINED MACHINE FOR SURFACE GRINDING AND POLISHING GLASS AND OTHER MATERIALS

David Bezborodko and Charles Zucker, Nice, France; vested in the Alien Property Custodian

Application filed May 27, 1941

The surface grinding or straightening treatment of the glass, the object of which is to remove all the waves or other inequalities on the surface of the glass, is realized by removing on both faces of the glass plate a thickness which was previously valued in a very approximative manner. By making use of this method, a too thick glass layer is removed, sometimes without any necessity, because the operator is forced to start from a very considerable depth. Abrasive materials of decreasing sizes must then be used and severe precautions must be taken during the various operations. Two surface grinding processes are currently used. According to one the square glasses are treated on round tables, however this treatment brings about a loss of 20 to 40% of materials and a great consumption of electricity, because of the particular construction of these tables. The wedging as well as the loosing of the glass on the table equally necessitate much labour.

The second process said continuous process saves some of the driving power and a great deal of labour. However, in spite of the fact that a great quantity of material is removed when the second process is applied to the laminated or drawn out glass, it is impossible to suppress, in any case, the waves which are of quite unlike depths and practically immensurable, because this process excludes any possibility of controlling the worker during the work. In this way, the defects can be seen only after the finishing, and for this reason this manufacture system gives but very little of silver-plattable glass. It is chiefly used for carriage-glass plates. Another drawback of this process is given by its very expensive installation, because it keeps still thousands of tons of cast-iron and a very important labour for its treating. Its use is justified only when the production is very great and it cannot be used in countries consummating small quantities of plane glass.

The combined machine for surface grinding or straightening the glass constituting the object of this invention performs, in an ordered manner, all the motions executed by a hand-polisher by routine. It eliminates all the drawbacks mentioned above and may eventually be used for the treatment of other materials such as marble, metals, wood and other materials. It offers the advantage of lowering the cost-price of the surface grinding or straightening treatment of glasses and may be applied even without abrasive materials by using natural or artificial grindstones. Owing to the new process the installation costs of a plate glass factory are greatly lowered.

With this machine it is possible to realize the surface grinding and polishing at once.

It is essentially characterized by the fact that it comprises the following elements taken together or separately:

(*a*) A device supporting a moveable frame vertically and means controlling this displacing such as a hydraulic piston, the said frame supporting the surface grinding and polishing organs for the glass.

(*b*) a surface grinding device supported by a frame effectuating a transversal to-and-fro horizontal motion and bearing only one planing wheel fixed in the centre of the said frame and receiving a rotation motion from a motor, this planing wheel regularly fed with abrasive matter rubbing on the glass plate fixed beneath, on a table describing a to-and-fro longitudinal motion, with a pressure depending on its own weight, the supplement of supple pressure being obtained by the compression of rubber rounds by the aid of a device comprising a hydraulic piston or any other implement.

(*c*) a polishing device comprising two or more groups of polishing wheels supported by the same frame describing a horizontal motion that bears the surface grinding device, these wheels rubbing on the glass plate with a graduated and supple pressure which may be regulated by the more or less great compression of rubber rounds. These wheels, in combination with the glass plate moving longitudinally with its support, describe six various motions forming a mosaic, and being raised periodically for the airing of the felt disks and the feeding in putty or abrasive mixture taking place during the ascending period, these devices secure a more rational feeding and reduce the material losses.

This invention also refers to a certain number of accessory devices to be used more particularly but not exclusively with this machine.

Thus, this combined machine for surface grinding and polishing may be used with a table supporting the glass, the to-and-fro motion of which is controlled, without a dead point, by the aid of a known device, said table comprising two parts the one of which having its longitudinal displacing controlled during the work by the aid of an individual motor or not, the other part directly supporting the glass being provided with stops for the mechanical fixation of the glass and drawing parts to displace it transversally outside the work; a cam fixed in the thickness of the table

on the whole of its length secure the instantaneous removal of the glass, even the finest one, without any risk of breaking it and electric lamps coloured if necessary and arranged in the said table enable to control the planing of the glass during the work. Small channels for the recovering of the waste abrasive matter as well as a protecting device surround the table supporting the glass.

With this machine and this table and by making use of any known or unknown device, the planing wheel may be fed with liquid abrasive matter across the disk.

It may also be fed from the exterior and even by the aid of dry abrasive matter distributed automatically by the longitudinal displacing motion of the table. Experience has shown that when working in the indicated manner, it was possible to realize a 20%–25% greater biting on the glass and consequently a corresponding economy in driving power. The formation of small protuberances hindering sometimes the wheel from being in contact with the glass on the whole surface, is thus avoided.

This invention includes, moreover, any other machine for surface grinding and polishing glasses comprising, in totality or in part, the application of similar arrangements.

It will be well understood, in any manner, by the aid of the description given hereafter and the annexed drawing given only by way of example.

Figs. 1 and 2 are elevation views respectively front and side views of the machine, with partial section.

Figs. 3 and 4 are schematical views respectively elevation and plane views of the controlling device of the frame supporting the drums.

Fig. 5, on a greater scale, gives a view of the bells and of the regulating devices for the pressure of the polishing wheels.

Figs. 6 and 7 are views of the polishing wheel respectively in section along the line 6—6 of the Fig. 7 and in plane seen underneath.

Fig. 8 is a scheme of the draught of the displacing having the shape of a mosaic described by a polishing wheel.

Fig. 9 is a schematic view giving the arrangement of the polishing spindles in the drums and their controlling device.

Figs. 10 and 11 are, on a great scale, schematic views respectively in elevation and in plane showing the airing mechanism of the polishing wheels.

Fig. 12 is a schematic view of the table supporting the glass.

Figs. 13 and 14 are, on an enlarged scale, detail views of the stops and the lamps placed in the alvearies of the table supporting the glass.

The machine is arranged on the fixed frame 2 comprising two guiding columns 3 between which a frame 4 may move vertically under the action of a hydraulic piston 102 or of any other suitable device; a frame 5 supporting all the grinding and polishing organs and any other controlling mechanism may move horizontally in the frame 4. The to-and-fro motion of the frame 5 (Figs. 3 and 4) is obtained by the aid of a mechanism supported by the frame 4. It comprises a motor 6 with the reducer 103 which controls, by the aid of the chain 7, a shaft 8 on the extremity of which a couple of angular pinions 9 acts upon two adjustable disk cranks 10 the connecting rods 11 of which impart to the frame 5 a horizontal motion the course of which may be regulated by displacing, on the said disk cranks 10, the oscillation point of the head of the connecting rods.

The frame 5 supports the complete grinding and polishing mechanism which comprises a motor 12 (Fig. 2) arranged on an upper platform 13. This motor acts, by the intermediary of belts or of a couple of cylindrical gears 14 and of a couple of annular pinions 15, a central shaft 16 on the lower extremity of which is fixed a plate 17 supporting the planing wheel 18.

The feeding of this wheel with abrasive matter is realized with the aid of dry abrasive. It is controlled by the motion of the table 49 and comprises, for instance, two funnels 104 and 105 opening alternatively, that on the right when the table travels to the right and that on the left when the table moves to the left; these openings may, moreover, be regulated according to the width of the glass to be worked.

For the surface grinding of the glass, the planing wheel 18 is lowered to its contact by opening the valve 113 which controls the piston 102. Then, with the aid of the nut 114, the upper extremity of the shaft 16 is brought into contact with the piston 107 which is movable in the cylinder 115, its displacing being controlled by the aid of the funnel 106, which open or shut the arrival and the discharge pipes for water under pressure 116 and 117. The going down of the piston 107 compresses the rubber round 32 thus bringing about the desired supple pressure of the wheel 18 on the glass.

The surface grinding of the glass is followed by the polishing which is realised by the same machine. For this purpose the planing wheel 18 is raised and dismounted for its removing. The polishing wheels 24 are then lowered close to the glass.

The central shaft 16 bears in its middle part a pinion 19 having a long bush which serves to drive the polishing mechanism. The latter is comprised in two drums 20 arranged on each side of the central shaft 16 bearing on its upper part a crown wheel 21 brought into gearing with the pinion 19 by raising the central shaft 16 after the planing of the glass.

The drums 20 then perform a rotation motion round their axle 118. In the described machine, each of them comprises five spindles 22; and each spindle bears a vertical pinion 23 on its upper part and a polishing wheel 24 on its lower part. These spindles 22 are arranged at various distances from the axle of the drum 20 (Fig. 2). For the driving of the polishing wheels is arranged on the upper part of each drum 20 a vertical motor 25 the axle 119 of which is eccentric with respect to that of 118 of the drums 20 and which serves to impart, through the suitable gears 26 and 27, a proper rotation to the spindles 22.

The whole of the drum with spindles and polishing wheels and driving motors is rigid connected with a bell 28. A connection through regulating screws 29, regulating fly-wheel 30 and connecting tie 120 is secured between the two bells 28 and a system of supple pressure constituted by an upper group 31 of rubber rounds.

This system completes the action of the springs 33 fixed on each spindle and serving to smooth the shock just as all the spindles come in contact with the glass. It is driven by the aid of a hydraulic piston 107 controlled by a valve fixed in 106 or in any other suitable manner and serves to obtain a graduated supple pressure from the polishing wheels, this pressure being determined in function of the work to be realized.

The airing of the polishing wheels takes place, for instance all the 45 revolutions described by the

drums **20**, by raising it. This motion is brought about by the aid of a star system **34** analogous to that of gas-meters which acts upon a cam **35** at regular intervals, this cam bringing about, intermediately a disk crank **36** and connecting rods **37**, the displacing on a double slope **38** of two pairs of carriages **39**. The drum is thus raised then lowered with the polishing wheels **24**.

The pressure of the tools on the glass may also be regulated by the aid of a clockwork which controls the upwards and the downwards motion of the drums and the compression, or by the aid of an electromagnet acting upon the valve **128** of the cylinder **115** of the piston **107** for shutting it after the going down of the drums in order to compress the rubber rounds and to open it to discompress them before their upwards motion.

The rational feeding of the wheels of each drum is effected with grinding putty mixed by two mixers **40** arranged in the frame. The mixers are brought into motion, in a continuous manner, by the aid of a motor **41** arranged on the upper part of the frame **5**, intermediately suitable transmissions. At their lower part is arranged a stop-valve **44** alternately opening and shutting their evacuation orifices at the lower part of each mixer. It is controlled by the ascending and descending mechanism of the polishing wheels in order to cause to fall on the glass, at each ascension of the wheel, the necessary layer of very diluted virgin putty. The mixer is heated electrically in order that the matter to be polished may be brought at a temperature sufficient to hinder the breaking of the glass during the feeding.

In order to secure its feeding with liquid, the planing wheel (Figs. 6 and 7) is provided, at the lower part, with a certain number of grooves **42** uniformly distributed under it as shown on the Fig. 6 and in the bottom of which are bored holes **43** emerging above the said wheel.

Pieces **45** forming borders to hinder the projection outside of the liquid brought in any suitable manner are fixed on the upper part of the wheel.

The polishing is carried out mechanically by the combination of six various motions:

1. A longitudinal motion of the table supporting the glass.
2. A transversal motion of the frame supporting the drums.
3. A rotary motion of the drum supporting the wheels.
4. A rotary motion of each polishing wheel.
5. An eccentric rotation motion of the whole of the groups each of these comprising five wheels.
6. The airing motion by going up and going down of the drums.

All these motions cause a displacing of each of the polishing wheels so that the whole constitutes a mosaic.

Fig. **8** gives a theoretical outline, in form of a mosaic, of nine runs of the polishing wheel, the order of these runs being appointed by the aid of the figures represented on this scheme.

This outline results from the combination of the longitudinal displacing motion of the table supporting the glass, on the one hand, and of the transversal displacing of the frame supporting the polishing tools, on the other hand.

In order to hinder the abrasive matter in the grooves of the planing wheel from falling upon the table **125**, when the glass is changed, a cover **46** (Fig. 6) is then placed on these wheels.

The table supporting the glass given in detail by Fig. 12 is arranged on a base **47** (Figs. 1 and 2) comprising a to-and-fro device, without a dead point, of a known model serving for its displacing controlled by the motor **123** by the intermediary of the device for direction changing **48** and the gear drive **124** arranged under the carriage **125** guided in its longitudinal displacing by the slide **126**.

The plate **49** provided with a system of sliding bars **50** is placed on the carriage **125**, the tightening of the glasses being realized mechanically by the aid of stops **52** foreseen in the sliding bars **50** (Figs. 12 and 13).

The plate **49** is movable in the slide **127** perpendicularly to the carriage **125**.

The border of the table as well as the under part are surrounded by grooves receiving the projected water and securing the removal of the waste abrasive matter.

A cam fixed in a groove **53** (Fig. 12) running along the whole length of the table is foreseen for the instantaneous loosening of the glass without any risk of breaking it even if it be very fine. This cam is controlled by the aid of a hand-lever **54** arranged on the side.

Electric lamps **55** (Figs. 12 and 14) are fixed in the table supporting the glass and serve to control the planing of the glass during the work.

At last, a protecting device **56** (Fig. 1) surrounding the table contributes to the recovering of the abrasive matter, prevents the accidents and protects the mechanical organs of the machine, and enables the workman to work without getting dirty.

Brushes such as **122** for the cleaning of the felt disks may be foreseen in certain parts of the frame.

It is clear that the invention is nowise limited by the example given above nor by the various parts described, but comprises, on the contrary, all possible variants. The planing and the polishing in particulars, may be realized on two distinct machines in which application is made of the arrangements given above. This execution manner may present some advantages in the more important installations where considerable quantities of glass are to be polished.

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CHARLES ZUCKER.

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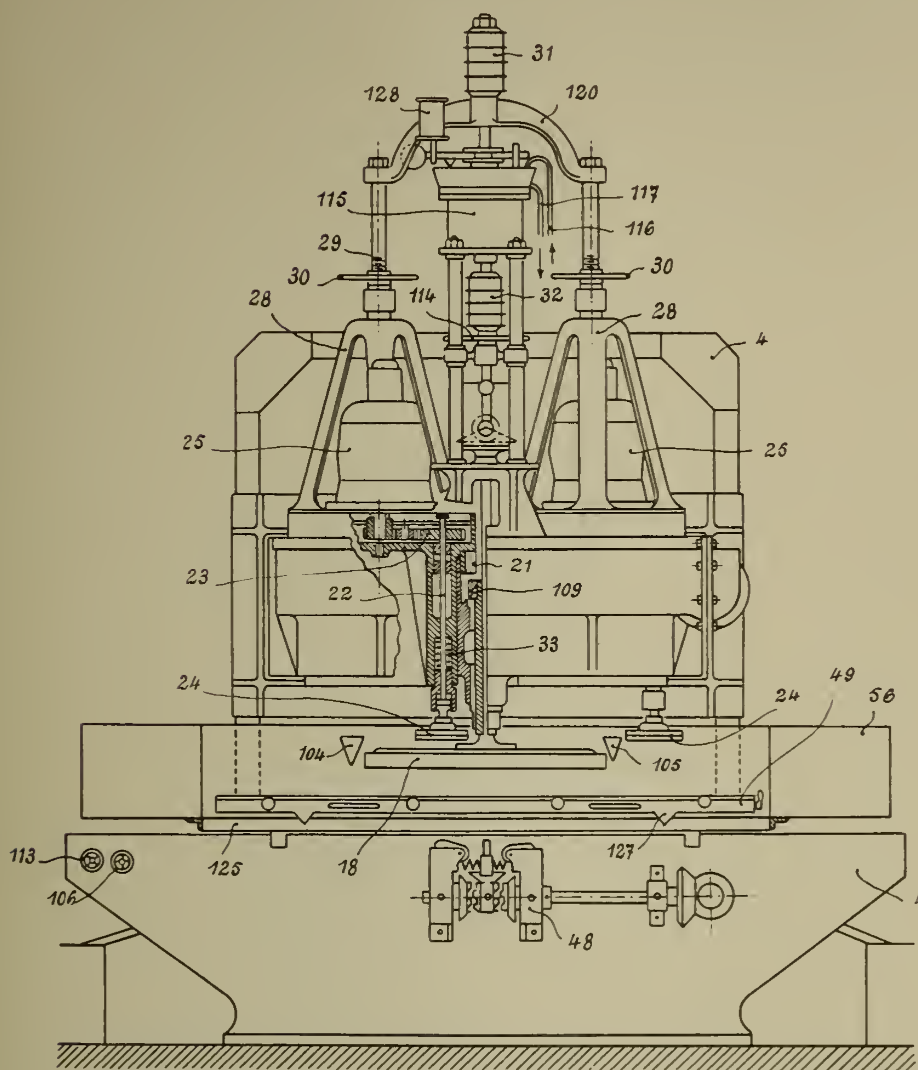
D. BEZBORODKO ET AL
COMBINED MACHINE FOR SURFACE GRINDING AND
POLISHING GLASS AND OTHER MATERIALS
Filed May 27, 1941

Serial No.
395,384

8 Sheets-Sheet 1

Fig. 1



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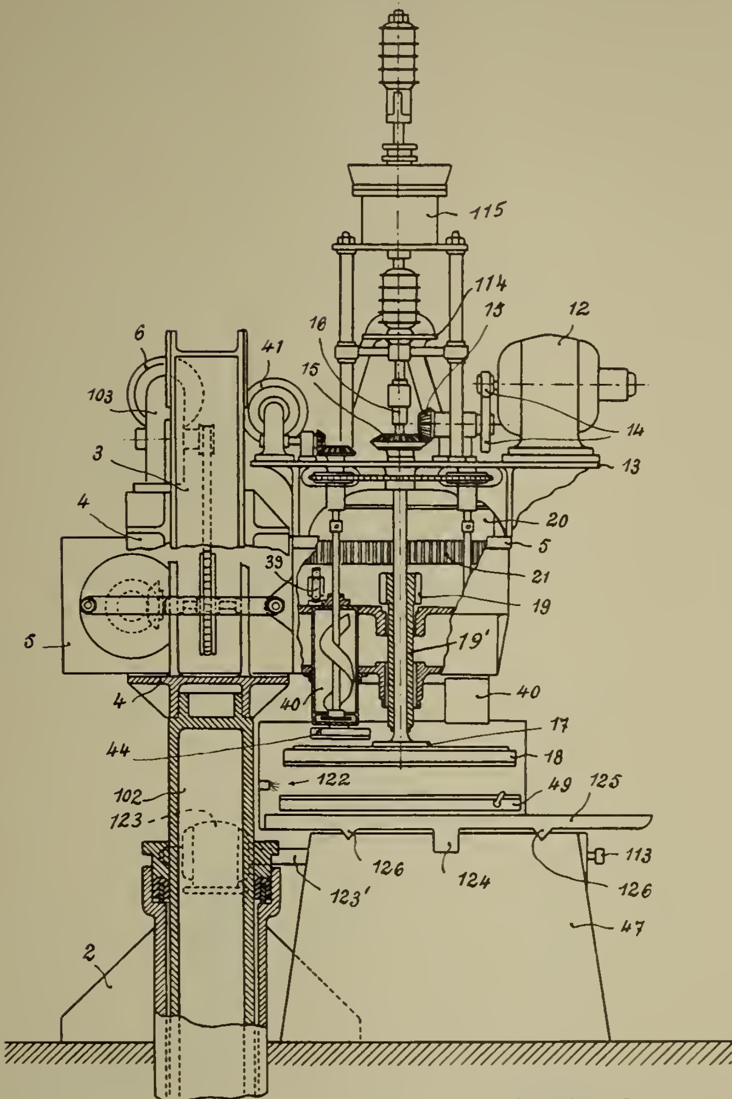
8 Sheets-Sheet 2

Fig. 2



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395,384
8 Sheets-Sheet 3

Fig. 3

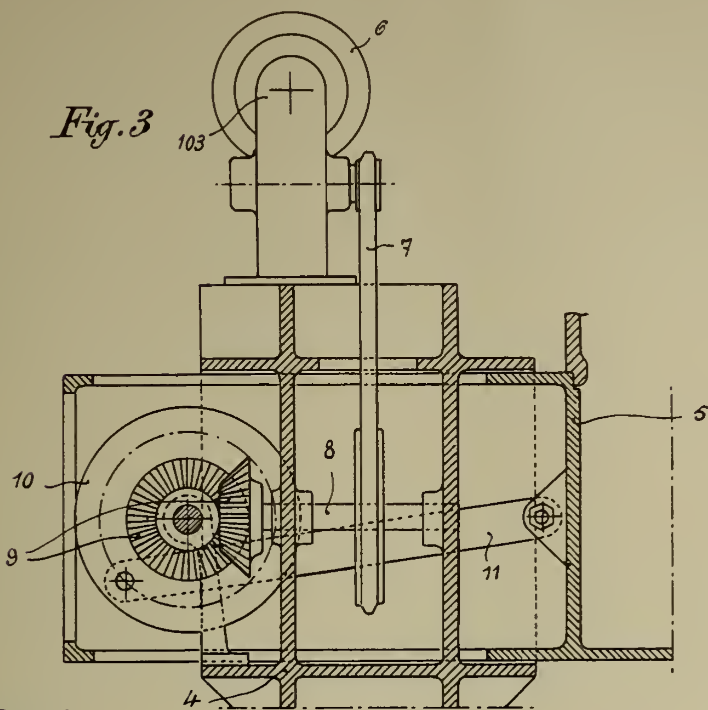

Fig. 4

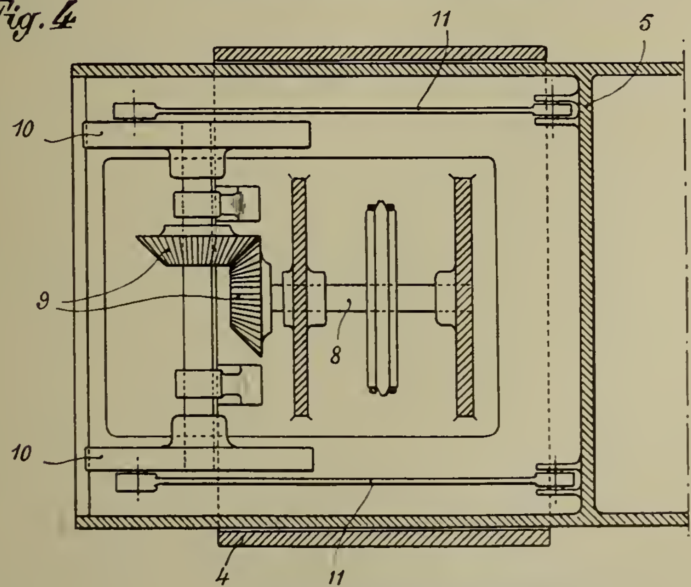

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Fig. 5

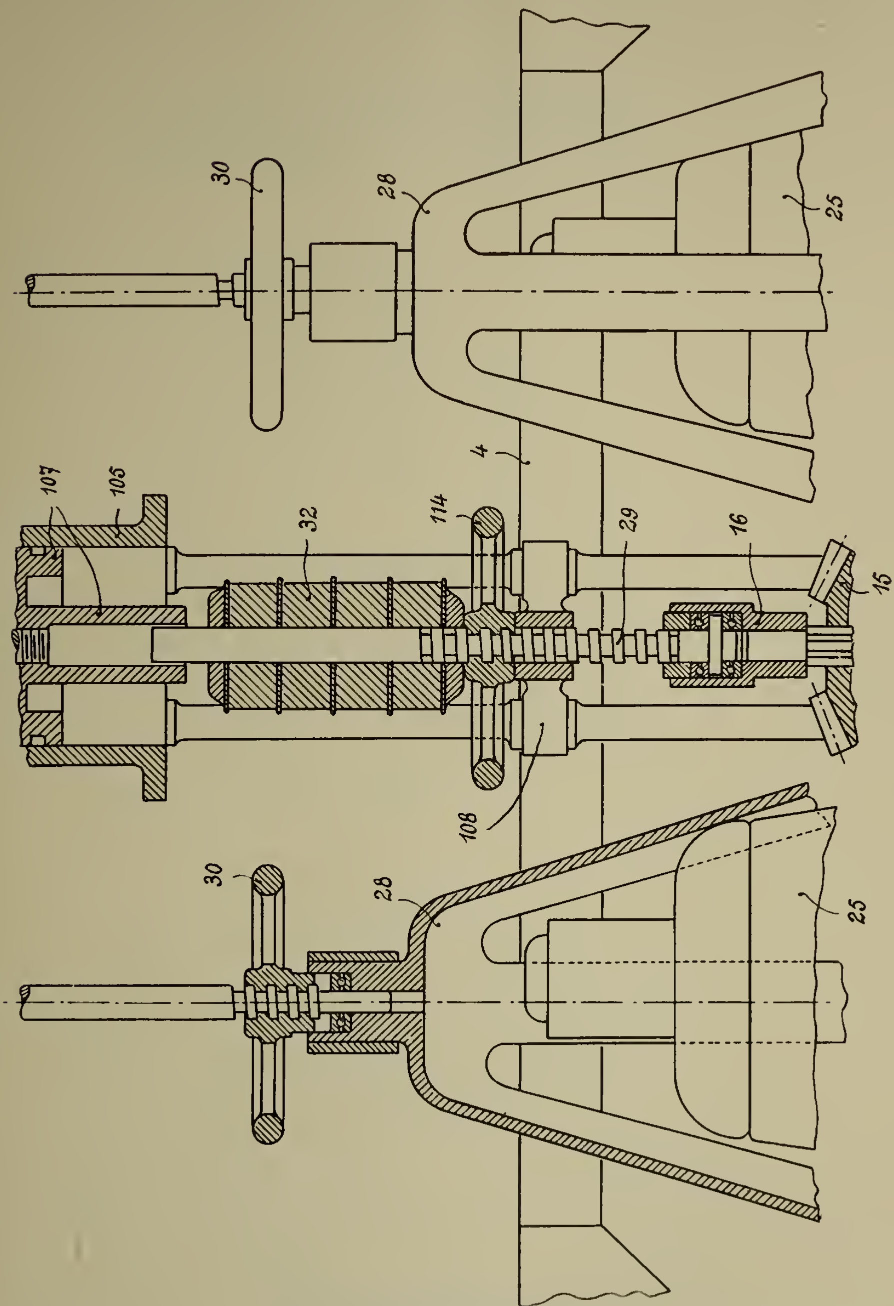

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Fig. 6

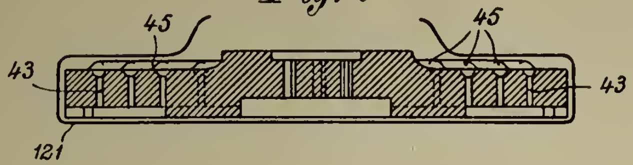


Fig. 7

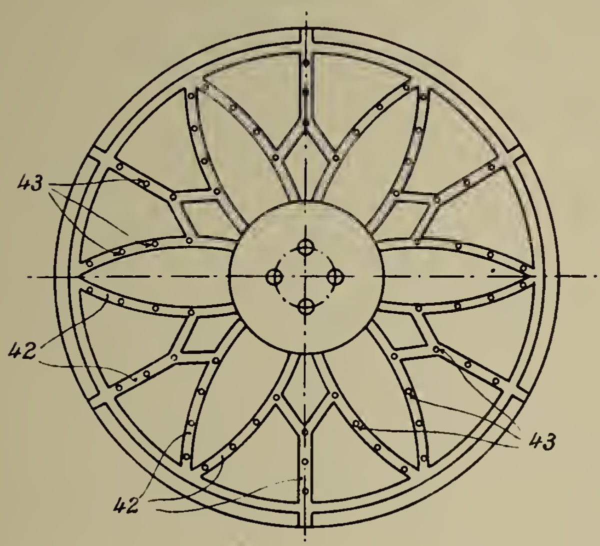
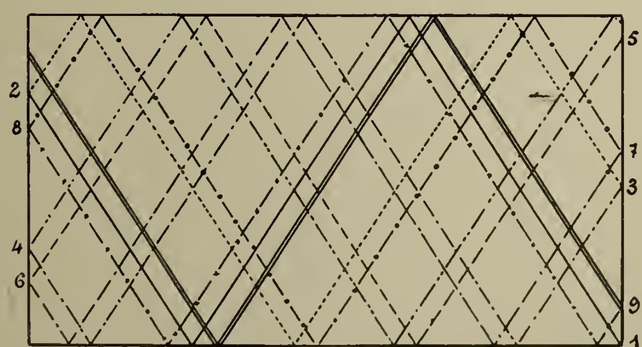


Fig. 8



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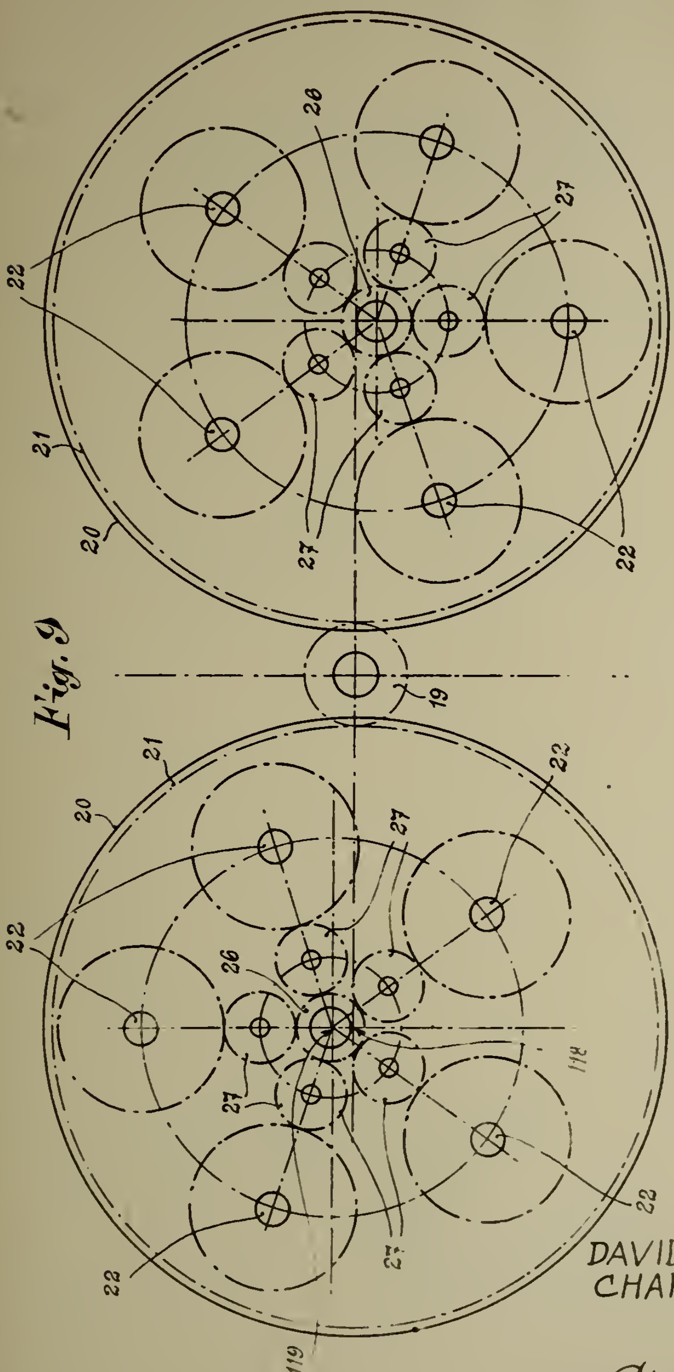

Fig. 9

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Fig. 10

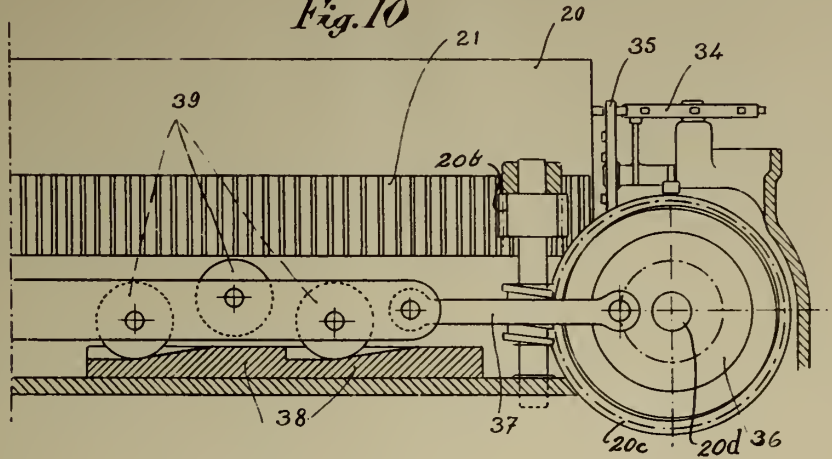
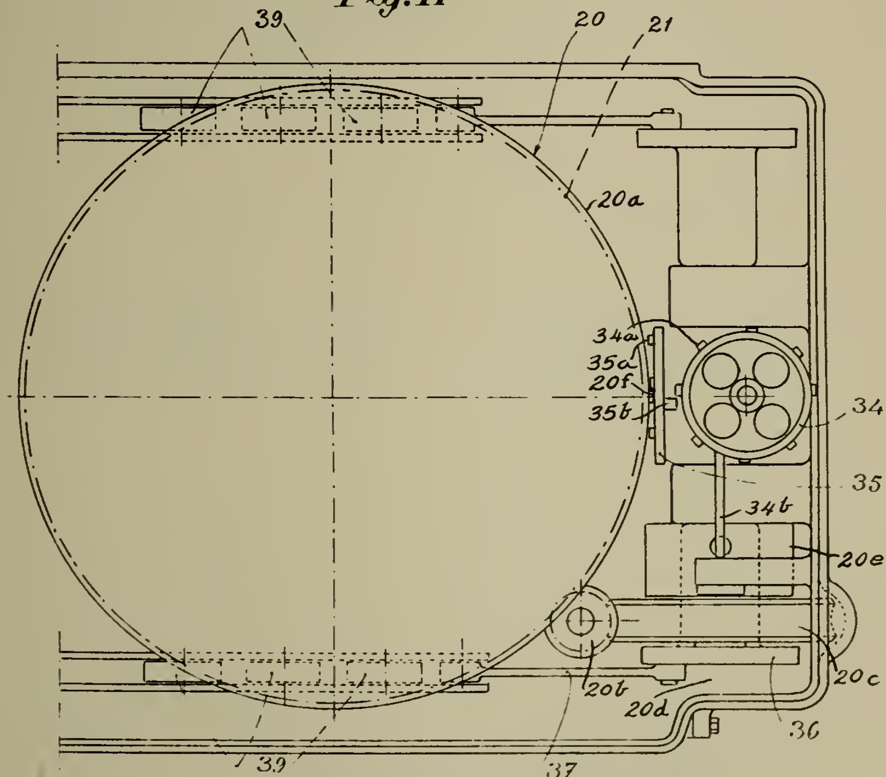


Fig. 11



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395,384
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Fig. 12

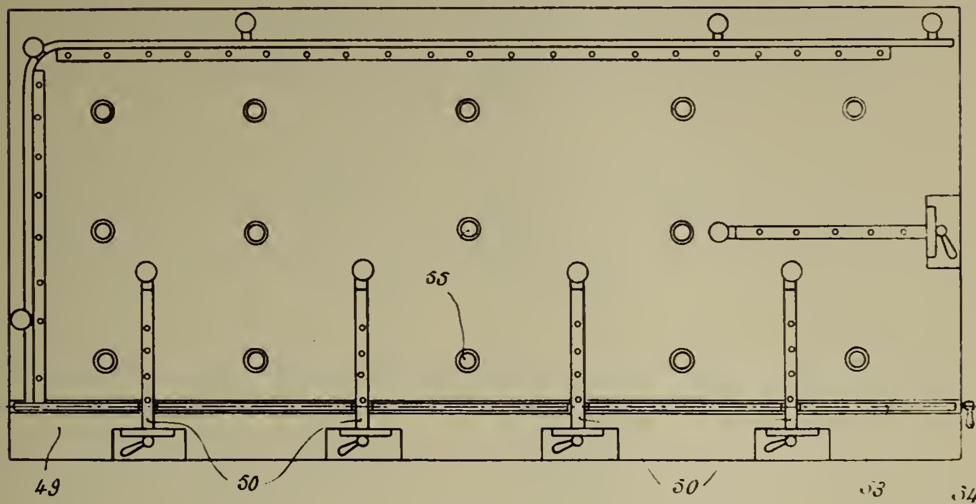


Fig. 13

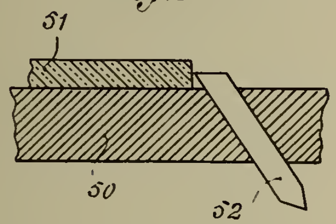
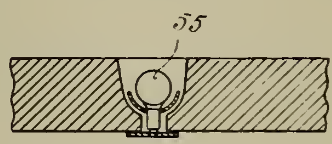


Fig. 14



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ALIEN PROPERTY CUSTODIAN

REFRACTOMETER FOR TURBID LIQUIDS AND PULPOUS SUBSTANCES

Gerhard Hansen, Jena, Germany; vested in the Alien Property Custodian

Application filed May 27, 1941

For determining the refractive index of liquids the known types of refractometers are being referred to as a rule, i. e. instruments where the liquid is brought in contact with a plane surface, known as the measuring surface of a measuring prism, and where in the visual field of a telescope the border line of the total reflexion of light on said measuring surface is looked for. In doing so, two different methods are usually resorted to viz., determining the position of the border line either by means of transmitted or of reflected light. The first method is well adapted for the investigation of colorless or very faintly colored liquids, while the second is preferred in the investigation of deeply colored liquids. That portion of the field which appears dark in transmitted light will appear bright in reflected light since it represents the region of total reflection on the measuring surface. The other part of the field which appears bright in transmitted light shows a diminished brightness in reflected light, since part of the light falling into said region on the measuring surface enters into the liquid and does not reach the telescope.

It has been shown that the readings of the known types of refractometers are reliable if the investigated liquids are clear. In the investigation of turbid liquids however difficulties are encountered by the dark part of the field being brightened as a result of the light being diffracted on those particles which are suspended in the liquid and which cause the turbidity. Depending upon the degree of the turbidity and upon the nature of the illumination the brightening in question is a differing one and in some cases is likely completely to compensate the difference in the brightness of the field at both sides of the border line, thus making it impossible for the border line to be perceived.

The present invention eliminates said difficulties and makes it possible to investigate also turbid liquids by means of the refractometer. In addition to this the refractive index of pulpous and even of solid plastic or elastic substances, as wax or soft rubber, for instance, can be determined by means of the refractometer according to the invention. The underlying idea is to utilize the light diffracted by the particles which are present in the substance under investigation and which cause the turbidity, while the light totally reflected from the measuring surface is prevented from entering the telescope. The refractometer is equipped with a measuring prism of whose bounding surfaces, which are perpendicular to one and the same plane, one serves for the entrance of light, a second one for the exit of light and a third one as the measuring surface to be brought in contact with the substance under investigation. With the aid of such a refractometer the problem in question can be solved if provisions are made to the effect that, as in accordance with the invention the light-entering surface of the measuring prism is approximately parallel to the measuring surface. The kind of illumination employed is then comparable with the dark-ground illumination as employed in microscopy.

In the case of certain types of refractometers, such as the socalled Works Refractometers, which are permanently attached to vessels containing the liquid to be supervised, it is not desirable that the optic axis of the telescope represent an acute angle with the measuring surface of the prism forming a window in the wall of the vessel, since this position would often render observations inconvenient. To avoid an undesirable angle of this kind it will be recommendable to so design the measuring prism that a fourth one of said bounding surfaces is provided to so deviate any light rays which have entered the prism perpendicularly to the light-entrance surface and have left the substance under investigation that they are about parallel to the entering light rays. In doing so a particularly simple design of measuring prism will result, if the light-entrance surface and the light-exit surface form parts of a common bounding surface of the measuring prism.

If in addition to turbid substances the same instrument is to be employed also for the investigation of clear substances, this can be effected in a simple manner by providing the measuring prism with a second bounding surface which serves for the light-entrance, this surface being inclined towards the measuring surface at an acute angle. This done, it will be possible, if so required to carry out measurements in reflected light in addition to those in diffracted light, in that in such cases the light-entering surface is disposed at about right angles to the entering light-rays. In designing such an instrument provisions must obviously be made ensuring that the light can reach the prism through one only of the two entering surfaces in order to obtain in the telescope a distinct border line free from any undesirable light.

In the annexed drawing different designs of the measuring prism and a works refractometer are illustrated representing constructional examples of the invention. Fig. 1 shows the simplest form

of the measuring prism for the purpose of elucidating the measuring process. Fig. 2 indicates a second constructional form of the measuring prism. A plan view of the works refractometer is given in Fig. 3 and a side view in Fig. 4 of the drawing.

The prism according to Fig. 1 is of square cross section. Two of its bounding surfaces lying at right angles to the cross section are parallel to one another. One of these surfaces marked 1 forms the measuring surface, while the parallel surface marked 2 serves as the light-entering surface. The light-exit surface 3 inclines at an acute angle towards the measuring surface 1. The fourth bounding surface 4 whose position is optional has been assumed in the example to be perpendicular to the two parallel surfaces 1 and 2.

The light enters in the direction of the arrow at about right angles to the light-entering surface 2 and after passing through the prism falls upon the measuring surface 1 at the same angle. Apart from slight partial reflexions on said two surfaces, the light enters undiminished into the turbid liquid 5 which is in contact with measuring surface 1 and whose refractive index is to be determined. The suspended particles in the liquid 5 diffract the light and the diffracted light once again enters into the prism: After the diffraction, a central ray of light 6 is being dispersed in the form of a pencil of rays 7 whose border ray 8 corresponds to the grazing incidence of light into the prism on the measuring surface of same. The diffracted rays originating from the light ray 6 thus brighten the region which in Fig. 1 lies at the left of the ray 8, while no diffracted light can reach the region at the right of said ray. In the same manner the light originating from other entering rays 9 is diffracted in liquid 5, whereby for each ray 9 a border ray 10 is formed which is parallel to the border ray 8. With the aid of a telescope lens 11 the rays 8 and 10 are fused to form a border line in such a manner that the one part of the field lying at one side of the border line appears dark and the other part lying at the other side of the border line appears bright. The angle formed by the measuring surface 1 and the light coming from liquid 5 and grazingly entering the prism is known to depend upon the refractive indices of the prism and of the liquid. This angle represents a measure for the latter refractive index, since the refractive index of the prism is invariable. To investigate a pulpous substance, a sample of said substance is applied to the measuring surface, whereupon the measurement is proceeded with same as in the case of liquids.

The second constructional example (Fig. 2) of the measuring prism is of pentagonal cross section. The bounding surfaces perpendicular to the drawn cross section are the measuring surface 12, the light-entering surface 13 parallel to the surface 12, a reflecting surface 14, the light-exit surface 15 and the bounding surface 16 which corresponds to the surface 4 of the prism according to Fig. 1 and which has no influence upon the path of the light rays. The reflecting surface 14 is so inclined to the measuring surface 12 that the diffracted light rays are reflected at an obtuse angle of such an extent that the emerging rays from relatively small angles with the direction of the entering light. The light-exit surface 15 lies at about right angles to the direction of the emergent light. To the position of said surface 15 the position of the telescope lens 17 is adapted. By imparting a suitable inclination to the reflecting surface 14, the light-entrance surface 13 and the light-exit surface 15 can be made to form parts of a mutual plane bounding surface of the prism.

This latter case has been materialized in the works refractometer illustrated in Fig. 3 and 4. Again, the measuring prism 18 is of square cross section, one surface 19 serving as measuring surface, a surface 20 parallel to the latter as light-entrance surface and light-exit surface too, a further surface 21 as reflecting surface and finally, a fourth surface 22 which can likewise be used as light-entrance surface. The surface 22 being intended for tests in reflected light. It is so inclined to the measuring surface 19 that, when testing a liquid having a mean refractive index, the entering light rays passing perpendicularly through surface 22 about form with the measuring surface the angle of total reflection.

The prism 18 is encased by a housing 23 which above a window 24 is screwed to the wall of a vessel 25 containing the turbid liquid 26 under investigation. Within the window 24 the liquid 26 is in contact with the measuring surface 19. In the wall covering the surface 20 the housing 23 is provided with an opening 27 for the entering light and with an opening 28 for the emergent light, while in wall covering the surface 22 a light-entrance opening 29 is provided. To close one of the two light-entrance openings when the refractometer is in use a lid 30 is provided. On housing 23 a pin 31 is fixed about which an arm 32 can be rotated. Said arm 32 carries a sleeve 33 within which a telescope 35 is clamped in position by means of a clamping screw 34. The optical parts of the telescope comprise an objective lens 36, furthermore, a glass plate 38 provided with a mark 37 and so disposed that said mark lies in the rear focal plane of said objective lens, and an ocular 39 consisting of an eye-lens and a field-lens. To the arm 32 also an arc 40 is fitted whose axis coincides with the axis of the pin 31. The arc 40 bears a scale 41 showing refractive indices which are indicated by a pointer 42 fastened to pin 31.

The refractometer is adapted for the determination of the refractive index of a turbid as well as of a clear and preferably colored liquid. When testing turbid liquids the opening 29 is closed by means of the lid 30. Apart from the additional reflexion on surface 21, the path of rays corresponds in this case to that as described in connection with Fig. 1. By swivelling the arm 32 the telescope 35 is to be set in such a manner that the border line visible in the rear focal plane of the objective 36 coincides with the mark 37. This setting having been attended to, the pointer 42 will indicate the refractive index of the liquid 26 on the scale 41. The liquid 26 being clear, the lid 30 is to be removed from the opening 29 and used for closing the opening 27. The light entering through opening 29 passes through the measuring surface 19, where it is diffracted, and then enters into the liquid 26. A certain direction of the entering rays produces in the liquid light rays grazingly refracted relative to the measuring surface 19. Light rays entering at a smaller angle to the measuring surface 19 will be totally reflected at the latter. By the fusion in the plane of the mark 38 of the border rays of the total reflection through the telescope lens 36, the image of the border line is produced which, as described before, is used for determining the refractive index of the liquid.

GERHARD HANSEN.

PUBLISHED

JUNE 1, 1943.

BY A. P. C.

G. HANSEN
REFRACTOMETER FOR TURBID LIQUIDS
AND PULPOUS SUBSTANCES
Filed May 27, 1941

Serial No.
395,408

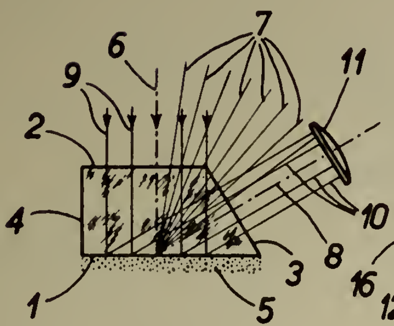

Fig. 1

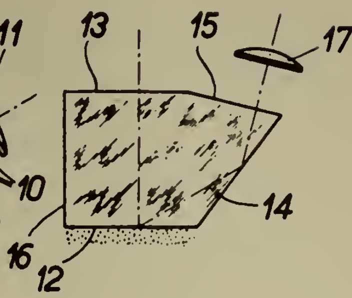

Fig. 2

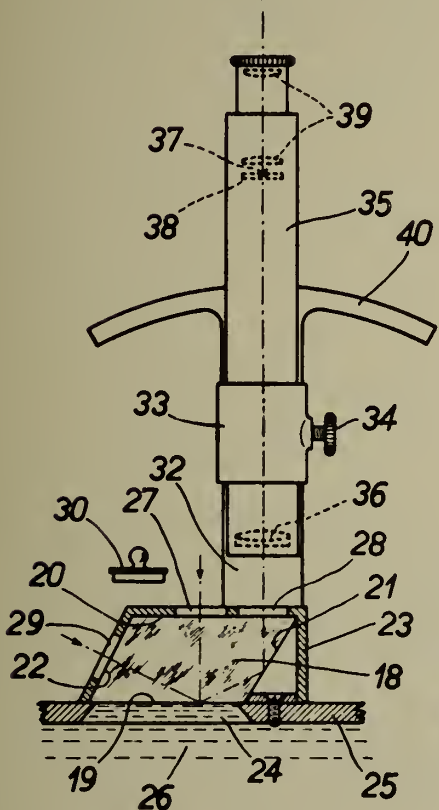

Fig. 3

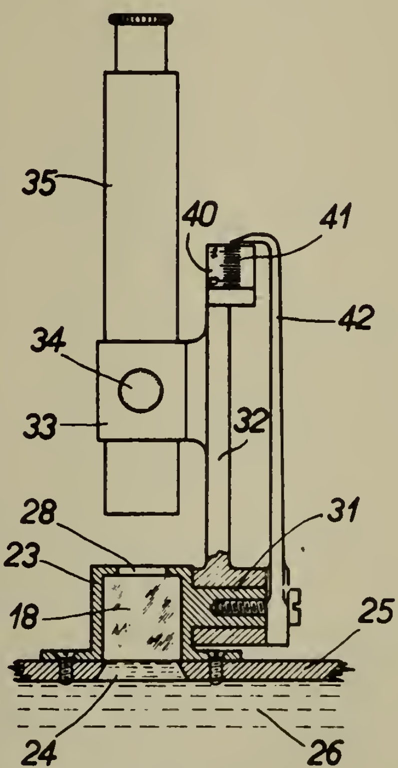

Fig. 4

Inventor:

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ALIEN PROPERTY CUSTODIAN

INTERNAL AND EXTERNAL GAUGE FOR REGULABLE MEASURING AND WITH MICROMETRIC ADJUSTMENT

Ugo Weiss, Milan, and Domenico Leone, Turin, Italy; vested in the Alien Property Custodian

Application filed May 27, 1941

The present invention relates to a gauge for internal and external control for regulable measuring and with micrometric adjustment.

Said gauge can vary as to the form, and therefore, some different types are illustrated by way of example.

The gauge according to invention can be of the boved type, one end of which is provided with a displaceable slide, while the other end is provided with a pair of micrometrically adjustable slides, and the slides of both ends can be locked in any position to obtain the necessary measures.

The gauge is particularly advantageous for the internal and external measuring within wide limits of diameters or dimensions.

It is possible to substitute the two slides with a single one, placing the micrometric screw in a suitable position, and to substitute the millimetric slide, provided with a vernier, with the basis adapted to threaded pieces.

Another type of gauge according to invention, only for internal measures, consists in a straight handle with two expanded ends. Each end is provided with two slides, adjustable by means of a hand nut with threads in opposite direction on the two sides, so as to allow contemporary balanced displacing of the movable parts, which are micrometrically adjustable.

The possibility of interchanging the slides allows to control very different internal dimensions.

According to invention, another type of gauge only for internal measures can be constituted with a straight handle, with an expansion containing micrometrically adjustable slides as above described this type differing from the foregoing in being simple instead of double.

Another type of gauge for internal measures consists of a handle provided with an expansion, containing said slides, being at least partially changeable and micrometrically adjustable by screw; one or more slides are graduated and the micrometric screw is fixed on a graduated drum serving as a vernier.

In all the above said types of gauges it is possible to interchange the slides and to apply verniers, and slides with appropriate ends for measures taken on the bottom of threads or otherwise machined pieces.

In the attached drawings,

Fig. 1 shows a bow-shaped gauge, according to invention;

Fig. 2 shows a section of Fig. 1 on the line A—A;

Fig. 3 shows a section of Fig. 1 on the line B—B;

Fig. 4 shows an internal gauge of the type with two expanded ends;

Fig. 5 shows the interchangeable parts of the gauge according to Fig. 4;

Fig. 6 a centesimal internal gauge, provided with a graduated slide and a vernier, and

Fig. 7 shows a section of Fig. 6 on the line A—B.

The gauge according to Fig. 1 consists of a bow handle 1, with expanded end portions 1—1'', having on the same plane a cavity for containing the slide 2 or the pair of slides 6; the slide 2 has such length that it can be displaced to the centre of the handle 1; the slides 6 are provided externally with a groove 7 engaging with the cylindrical collar 8 of a micrometric screw 8', so that the rotation of the screw produces a longitudinal displacement of the corresponding slide. The above said slides are maintained in place by plates 3 fixed on the expanded ends by means of a plurality of screws 4. The slide 2 and both of the slides 6 can be locked in any position for the necessary measure by means of the conical pivots 5 to be forced on the sides of the slides.

The gauge according to Fig. 4 consists of a handle 9, which has expanded ends 10 and 11, each of them having two slides, 12 and 14, 13 and 15, micrometrically adjustable by means of the hand screws 16 and 17.

Fig. 5 shows some interchangeable slides of different length, for the gauge according to Fig. 4.

Fig. 6 shows in front view a centesimal gauge for internal measures, having a graduated slide and a vernier.

Fig. 7 shows a section on line A—B of Fig. 6; 18 the back plate, and 24 the front plate. The back plate 18 has a groove with an expansion containing two interchangeable slides 19 and 20, moved by the micrometric screw 21, having a graduated drum 22, serving as a vernier.

The micrometric screw 22 has an internal cavity in which is placed a spring 26 pressing the ball 25 to ensure a sufficient friction on the centesimal drum to allow rotary displacement for calibration in the zero position of the apparatus.

Slide 20 has a graduated scale, which can be seen through an aperture in the front plate 24.

In all the types of gauges, illustrated as examples, it is possible to interchange the slides, to engrave graduated scales on said slides, and to apply a vernier.

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INTERNAL AND EXTERNAL GAUGE FOR REGULABLE MEASURING AND WITH MICROMETRIC ADJUSTMENT

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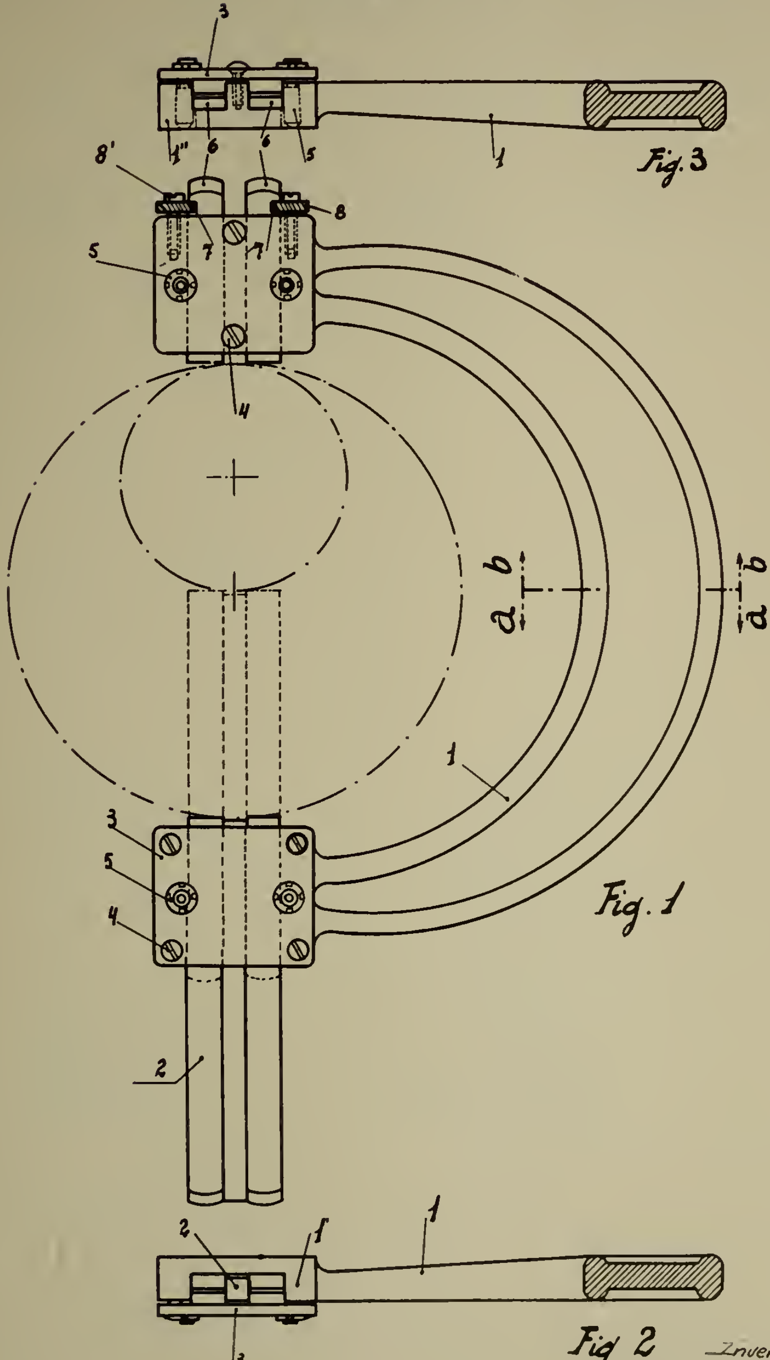
Serial No. 395,500

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

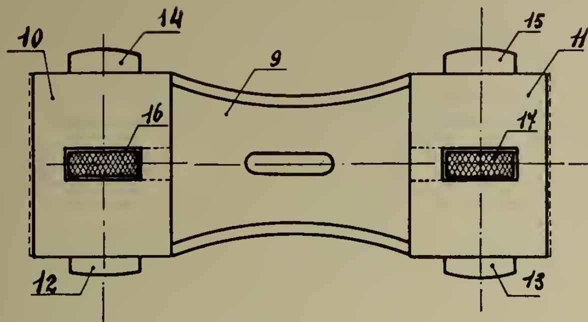

Fig. 4

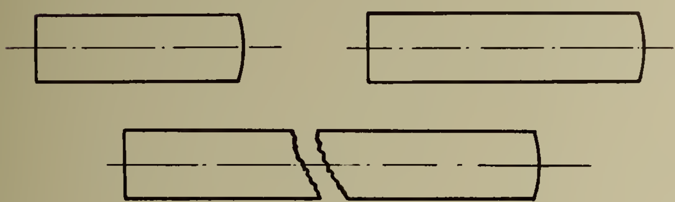

Fig. 5

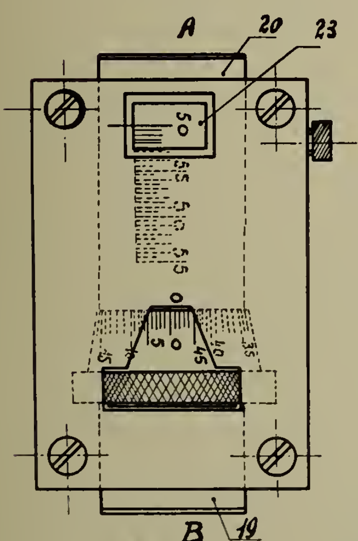

Fig. 6

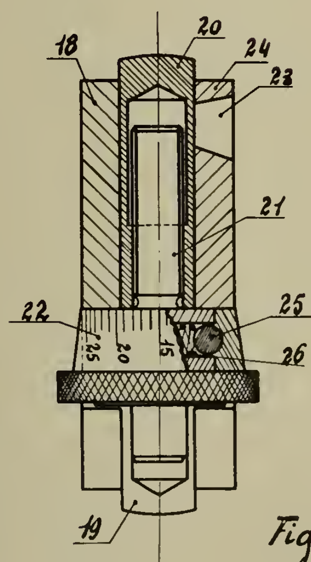

Fig. 7

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ALIEN PROPERTY CUSTODIAN

LIGHT-SOURCE IN CONNECTION WITH A FILTER

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Application filed June 9, 1941

Knowledge has been obtained of a suggestion whereby a light-source is to be connected with a filter which transmits part of the radiation emanating from the light-source and which reflects the remaining part of such radiation. The device was intended to transmit the visible radiation while the infra-red invisible radiation was to be thrown back upon the light-source, so as to increase the temperature of the latter and thus to enhance the output of energy. The filter to be used in this connection was to consist of a thin layer of metal such as of gold for instance.

According to the invention however the problem in question cannot be solved unless the filter resorted to is one of the interference type, i. e., a filter consisting of several thin layers where the radiation is split up by interference phenomena into a transmitted and a reflected portion of light. The material difference between said filters and those consisting of a single thin layer of metal lies in the following: A single metal layer, though being capable of transmitting the visible and reflecting the infra-red radiation, is not however adapted for bringing about an improvement in the energy output, since, if by means of such a metal layer the infra-red radiation, is to be substantially reflected, the visible radiation will be absorbed by said layer to such a high degree that the increase in the temperature of the light-source occasioned by the radiation being thrown back upon it just about suffices to compensate the loss of visible radiation caused by said absorption. Interference filters, however, can be so designed that the desirable radiation will be transmitted to a high degree while at the same time the undesirable radiation is reflected to a high degree. Interference filters are for this reason adapted for increasing the entire output of light and for achieving the approximate state of cold radiation outside of the device.

The following is cited as a numerical example. Supposing, for instance, that in accordance with the aforegoing suggestion a 20 mμ gold layer be used, then its reflexion for infra-red rays of a wavelength of 1 μ will amount to about 85% and its transmission for yellow light of 578 mμ about 40%. Hence, as demonstrated by a computation, the influence of the reflexion of the infra-red rays upon the light rays only just suffices to compensate the loss caused by the absorption of the visible radiation, i. e. the energy output is not being increased. A silver layer of 25 mμ thickness would likewise result in the reflexion of the radiation of a wavelength of 1 μ amounting to about 85%, while its transmission for for light of a wavelength of 578 mμ would amount to anly about 20%, so that the energy output would be inferior to that obtained with a thin gold layer or in other words, the output would be less satisfactory than without the employment of a filter altogether. However, when using an interference filter consisting of two silver layers of 25 mμ thickness each and of a collodium layer of 1 μ thickness a reflexion of 95% is obtained for infra-red radiation and thereby a transmission of 35% for yellow light. A computation shows that, with the energy requirements being reduced to a half, the same output of visible radiation is obtained as would be the case without the employment of any filter at all.

The device in question can be designed in many varying ways. What it will be expedient to avoid if possible, is that the rays fall on absorbing layers prior to falling upon the interference filter as the radiation so absorbed is practically no longer available for increasing the temperature of the light-source. Hence, when using an incandescent lamp as a light-source, purposes will best be served if the filter is provided for in the interior of the bulb.

A particularly suitable design of the invention results if the light-source is disposed in a searchlight projector which essentially projects parallel light rays and if the opening of said projector is closed by an interference filter. In the case of such an arrangement the projector may be one of the usual design, it requiring but the interposition of the filter to impart to it the advantages achievable by the invention.

In the annexed drawing a constructional example of the invention is illustrated in section. A light-source A is situated in the focal point of a parabolic metal reflector *a*. Concentrically to the light-source a spherical-reflector *b* is disposed. The opening of the parabolic reflector *a* is closed by an interference filter *d* held by a mount *c*. The dimensions of the spherical reflector are so chosen that it reflects upon the light-source all rays which would fall upon the interference filter, without having previously fallen upon the parabolic reflector.

The rays reflected by the parabolic reflector fall upon the interference filter. Unless not absorbed, but reflected by said filter, the parabolic reflector will reflect them upon the light-source whose temperature they will increase.

The constructional example illustrated in the annexed drawing contains a searchlight projector of the usual type to which an interference filter has been added.

WALTER GEFFCKEN.

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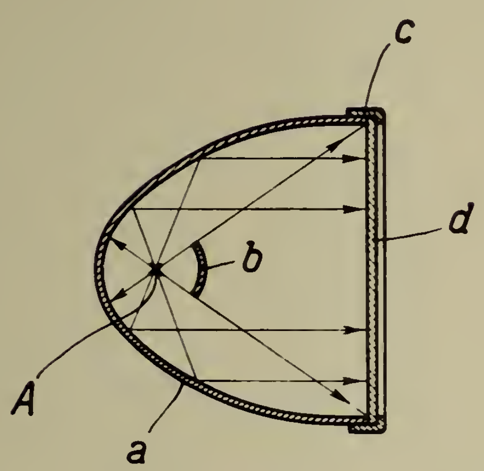
W. GEFFCKEN

LIGHT-SOURCE IN CONNECTION WITH A FILTER

Filed June 9, 1941

Serial No. 397,213



Inventor:

Walter Geffcken

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ALIEN PROPERTY CUSTODIAN

PLANT FOR THE REMOTE CONTROL OF A GATE-VALVE BY MEANS OF A FLUID UNDER PRESSURE

Emile Piquerez, Saint-Cloud, France; vested in the Alien Property Custodian

Application filed June 13, 1941

The present invention has for object a plant for the remote control of a gate-valve made in one piece, by means of a fluid under pressure.

The object of the present invention is a plant having a central station from which it is possible to control from a distance the opening of one or of a plurality of blow-off valves for the accelerated draining of tanks containing relatively important quantities of liquids, particularly inflammable liquids, and from which it is possible to effect the supervision of said plant, in particular for detecting therein the leakages which might occur of the liquid to be drained or of the fluid under pressure utilised for the acceleration.

The plant according to the invention is characterised by the fact that the action of the fluid under pressure is exerted on the draining only after it has caused the opening of the blow-off valve, and this in order to avoid any pressure liable to cause the bursting of the fluid-tight tanks to be drained. This arrangement allows in certain cases to interpose between the mechanism opening the gate-valve and the tank to be drained any known regulator allowing to reduce the importance of the pressure above said tank.

The plant is also characterised by the arrangement, within the gate-valve, of a double stuffing-box provided in communication with the central station in such a manner that the possible leakages of the two kinds of fluids can be immediately detected.

The blow-off valve of the plant according to the invention is characterised by the fact that:

The stuffing-box is interposed in the gate-valve between the inlet of the fluid under pressure and the draining passage for the liquid to be drained, so as to prevent the leakages of both kinds of fluids and is provided with a device for taking up the play operable from the exterior.

The stuffing-box has two fluid-tight zones separated by a central space provided with a nozzle for the connection of the pipe line detecting the leakages leading to the central station.

The closing slide of the gate-valve is controlled by a rod passing through the double stuffing-box and carrying, on the side opposed to the slide, a locking piston.

The bolt of the locking piston and the locking piston are movable by the pressure of the fluid under pressure.

The closing slide of the valve comprises two half-shells pivoted on each other, the pivotal centre being chosen in such a manner that the resultant of the pressure is exerted on the covers according to the axis of the outlet passage of the gate-valve.

The cylinder in which moves the bolt of the piston locking the gate-valve is provided with an outlet to the atmosphere which is obturated during the draining period by a valve rigid with the bolt.

A resilient device is interposed between the slide and the control rod in order to avoid jammings during the closing stroke.

Other advantages and characteristic features will become apparent from the following description given with reference to the accompanying drawings by way of example which relate to a plant for the draining of inflammable liquids and in which:

Fig. 1 is a vertical section of the gate-valve in closed position.

Fig. 2 is a view of the gate-valve, in open position, partly in elevation and partly in vertical section according to a plane at right angles to the plane of section according to Fig. 1.

Fig. 3 is a view in horizontal section according to line III—III of Fig. 2, partly in closed position, partly in open position.

Fig. 4 is a plan view of the lower part of the gate-valve, partly in horizontal section according to line IV—IV of Fig. 1.

Fig. 5 is a view in horizontal section, made partly through the nozzle for the outlet of the protecting fluid under pressure such as CO^2, partly through the plane of the device for taking up the play of the stuffing-box.

According to the embodiment chosen by way of example and which is provided for the draining of inflammable liquids, the lower part of the gate-valve is in the form of an inverted T the tubular horizontal branch **1** of which constitutes the draining passage **2** for the inflammable liquid and the tubular vertical branch **3** of which constitutes the bore **4** according to the axis of which moves the closing slide of the gate-valve. The horizontal branch **1** comprises flanges **5** and **6** respectively for connection to the inflammable liquid tank and the conduit for evacuating the liquid to be drained. The bore **4** which extends down to the bottom of the horizontal branch **1** is suitably obturated by means of a bottom **7** with interposition of a packing **8**.

The bottom **7** is made in one piece with a cylindrical extension **9**, the whole being internally threaded for receiving a maintenance plug **10**.

The bottom 7 is also provided with a recess 11 the shape of which corresponds to that of the covers 12 closing the draining passage 2, so that said covers can suitably abut against said bottom when the gate-valve is in closed position.

At its upper part the vertical branch 3 comprises a flange 13 on which can be secured by a flange 14, with interposition of a packing 30, a tubular element 15 provided with a bore 16 in which can move a locking cylinder 17 connected to the rod 18 controlling the closing slide, as will be more fully described hereinafter.

This tubular element 15 comprises a horizontal branch 19 suitably bored to receive a bolt 20 subjected to the action of a spring 21 which takes a bearing on the internal surface of a plug 22 screwed at the end of the branch 19 with interposition of a fluid-tight washer 23.

An outlet to the atmosphere 24 is provided in the bottom of plug 22, said outlet 24 being closed, when the gate-valve is in service, by a valve 25 rigid with the bolt 20.

At its upper part the tubular element 15 has a flange 26 on which is secured, with interposition of a packing 27, a closing plate 28 provided with a tapping 29 for the connection of a conduit, not shown, leading to a multi-way distributor placed at the central control station.

The locking cylinder 17 is mounted on the control rod 18 with a damping device adapted to absorb the shocks which occur at the end of the opening stroke.

The damping device is thus constituted: a tailpiece 31 which terminates at its lower part in an internally threaded portion 32 screwed on the end, screw threaded for that purpose at 33, of the control rod 18. The internally threaded portion 32 which has a diameter larger than that of the tail-piece 31 is housed, with a certain amount of play, in a recess 34 provided within the locking cylinder 17. The recess 34 is followed at the upper part of the cylinder 17 by a tapping of larger diameter 35 in which is screwed a sheath 36.

The annular space 37 provided between the tail-piece 31 and the interior of the sheath 36 is used for receiving a damping spring 38 which, taking a bearing on the shoulder 39 of the tail-piece 31, reacts on the other hand, against the bottom of the sheath 36 rigid with the locking cylinder 17, the reaction of the spring 38 being limited by the clearance provided between the cylinder 17 and the control rod 18; said clearance being in its turn limited by a shoulder 40 provided within the cylinder 17 which abuts against the lower part of the internally threaded portion 32 of the tail-piece 31.

The cylinder 17 is of course provided with packing-rings ensuring fluid-tightness within the bore 16, it is also provided with an annular groove 41 in which can engage, when the gate-valve is in closed position, under the action of the spring 21, the head 42 of the bolt 20.

Between the head 42 and the main body of the bolt is provided a portion 43 of smaller diameter than that of said body in order to provide, in locking position, a free annular space 44 opposite which is located the nozzle 45 through which is admitted the protecting fluid under pressure, said nozzle 45 being connected to the horizontal branch 19.

Slightly higher up the tubular element 15 is provided with a nozzle 46 through which the protecting fluid is directed towards the liquid to be drained when, after having been unlocked, the locking cylinder 17 has been moved to the upper part of the tubular element 15.

The tubular element 15 presents, directly above its flange portion 14, a solid portion 47 and downwardly from said flange, a cylindrical extension 48.

A hole 49 bored in said lower part extends to a shoulder 50 of the solid portion 47.

Said bore 49 is used to house a double stuffing-box having, in the order from top to bottom: a first packing 51, a bracing ring 52, a second packing 53 and a clamping ring 54 which receives the pressure of a spring 55 adjustable at will by the more or less accentuated screwing of the nut 56 in a tapping of the extension 48. Said nut comprises a flange 57 in which are perforated a certain number of radial holes 58 which can receive the end of a tightening rod 59 which can be inserted in an opening 60 provided in the tubular branch 3 after having removed a plug 61 removably mounted in a fluid-tight manner on said branch 3.

The bracing ring 52 is I-shaped so as to provide, between both packings 51 and 53, an annular space 75 which, through the medium of a conduit 76 and a connecting tapping 77 can be put in communication with a device for supervising the leakages placed at the central control station within sight of the superintendent.

The covers 12 are centered on spherical projections 62 and 63 of two shells 64 and 65, the centre common to both these spherical projections being located on the intersection of both axes of the gate-valve.

The two shells 64 and 65 are pivoted on each other, the pivotal centre 66 being located on the vertical axis of the gate-valve slightly above the plane passing through the horizontal axis of the gate-valve.

The distance between the horizontal axis and the pivotal centre 66 is so chosen that when the end of conical shape 67 of rod 18 exerts a thrust on corresponding cones 68 and 69, respectively provided on the shells 64 and 65, the resultant of said thrust is exerted on either side, according to the horizontal axis so that the closing surfaces of the covers are correctly applied against their respective seats on the gate-valve.

Said thrust, which is useful for ensuring fluid-tightness, constitutes an inconvenience when it is desired, after the opening period of the gate-valve, to bring back the covers 12 to their closed position. If said thrust could not be relieved, jammings between the covers and the bore 4, might be produced and, in any case, the friction would be important.

For avoiding this inconvenience, the thrust transmitted to the rod 18, is only directly exerted on the conical parts 68 and 69 of the shells 64 and 65 when the covers 12 and 13 have abutted against the recess 11 of the bottom 7 of the gate-valve, that is to say, in their practically closed position.

As long as the contact between said covers and the bottom 7 is not obtained, the thrust of the rod 18 is transmitted through the medium of a resilient device.

The rod 18 presents, within the two shells 64 and 65, a shoulder 70 against which abuts, under the action of a spring 71, a washer 72. The spring 71 reacts, on the other hand, against a washer 73, which in closed position, presses against a shoulder 74 common to both shells.

Assuming that, in the central station, there is a supply of protection gas under pressure, for

instance CO^2, connected to a multi-way distributor controlled by the superintendent, and that one of the ways of the distributor can be connected to the nozzle **45** admitting the fluid under pressure to the gate-valve, whereas the other way which is connected to a connection in engagement with the tapping **29**, remains closed, the operation of the plant, if it is necessary to rapidly drain an inflammable liquid contained in a tank to which the flange **5** of the gate-valve is connected, is as follows:

The superintendent of the station puts the distributor in the position in which the CO^2 gas can reach the nozzle **45** of the gate-valve, the admission takes place in the free annular space **44**, the pressure pushes back the bolt **20** and disengages its head **42** from the annular groove **41**.

The pressure of the CO^2 gas pushes back the bolt **20** in antagonism to the action of the spring **21** until the needle of the valve **25** closes the outlet **24**, in this position the passage which connects the annular space **44** to the bore **16** is already open and the pressure is exerted under the locking piston **17** which, through the medium of its shoulder **40**, displaces the control rod **18** upwardly.

During said upward movement of the operating rod **18**, the lower cone **67** of of said rod is separated from the cones **68** and **69** of the shells **64** and **65** thus relieving the covers **12** of the thrust which pressed them against their seats, or practically, against the bore **4** and thereby the closing slide can effect its opening stroke without appreciable friction. It is to be noted that the beginning of the upward movement of the rod takes place without shock on the slide owing to the interposition of the spring **71**.

At its upper part the pressure has been transmitted from the locking position **17** to the rod **18** and when the latter reaches the end of its upward stroke, that is to say against the closing plate **28**, the shock on the sheath **36** is damped by the damping spring **38**.

In this high position of the rod **18** the draining passage **2** of the gate-valve is open and the fluid under pressure used for accelerating the draining can freely issue through the nozzle **46** which is then located below the locking piston **17**.

The nozzle **46** being connected by a conduit, not shown, to the tank for the liquid to be drained, the pressure will be exerted on said liquid which will flow through the draining passage **2** towards the place where it is to flow away.

It will be noted that the pressure of the fluid accelerating the draining can only be exerted when the blow-off valve is open and that the tank for the liquid to be drained is thus subjected to no dangerous pressure. Furthermore, the pressure may be adjusted between the nozzle **46** and the tank, by means of any regulating device suitably arranged on the conduit connecting these two points.

Assuming it is advisable to reclose the gate-valve, the superintendent closes the passage leading to the nozzle **45** and establishes the communication with the way of the distributor which is connected to the tapping **29**. The pressure acts on the locking cylinder **36**—**17** which transmits the thrust to the rod **18** through the medium of the shock absorber **38**, when the rod **18** reaches its closed position the bolt **20** pushed back under the action of the spring **31** plays its part automatically, and the gate-valve is again locked in its closed position.

During its downward movement the rod **18** transmits the thrust on both shells **64** and **65** through the medium of the spring **71** and of the shoulder **74**, leaving a certain clearance between the lower cone **67** and the conical surfaces **68** and **69**; the covers freely sliding in the bore **4**. As soon as the covers **12** abut against the bottom **7**, the spring **71** can no longer act and the thrust on the shells is directly transmitted by the conical parts.

The thrust exerted by the cone **67** on the shells **64** and **65** causes the latter to pivot about their common center **66** and the resultant of said thrust on each of these two shells tends to press the covers **12** against their seats, the pressure being suitably directed on either side according to the horizontal axis of the draining passage **2**.

The leakages which might occur through the double stuffing-box **51**—**53**, respectively in CO^2 and in inflammable liquid, are immediately pointed out to the superintendent of the central station which is connected to the intermediate annular space **75** of the stuffing-box by the conduit connecting said station to the tapping **77**.

If such leakages occur, the double stuffing-box must be put in suitable condition. For that purpose, it suffices to remove the plug **61** and by using the opening **60** (Fig. 2), by means of the tool **59** (Fig. 5) to tighten the nut **56**.

It is to be understood that the embodiment illustrated only by way of example has been described simply as an indication and not in a limiting sense, and that all modifications might be made therein without changing the nature of the invention.

Thus, for instance, the plant might be equipped for simultaneously opening a plurality of gate-valves connected to one and the same tank, or for simultaneously draining a plurality of tanks, provided however that the pressure is only exerted on the tank or tanks after the opening of said gate-valve or gate-valves.

The plant can also be applied in numerous cases to the treatment of hydrocarbons in particular for the recovery of secondary products. The various controls might also be obtained hydraulically instead of pneumatically.

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3 Sheets-Sheet 1

Fig. 1.

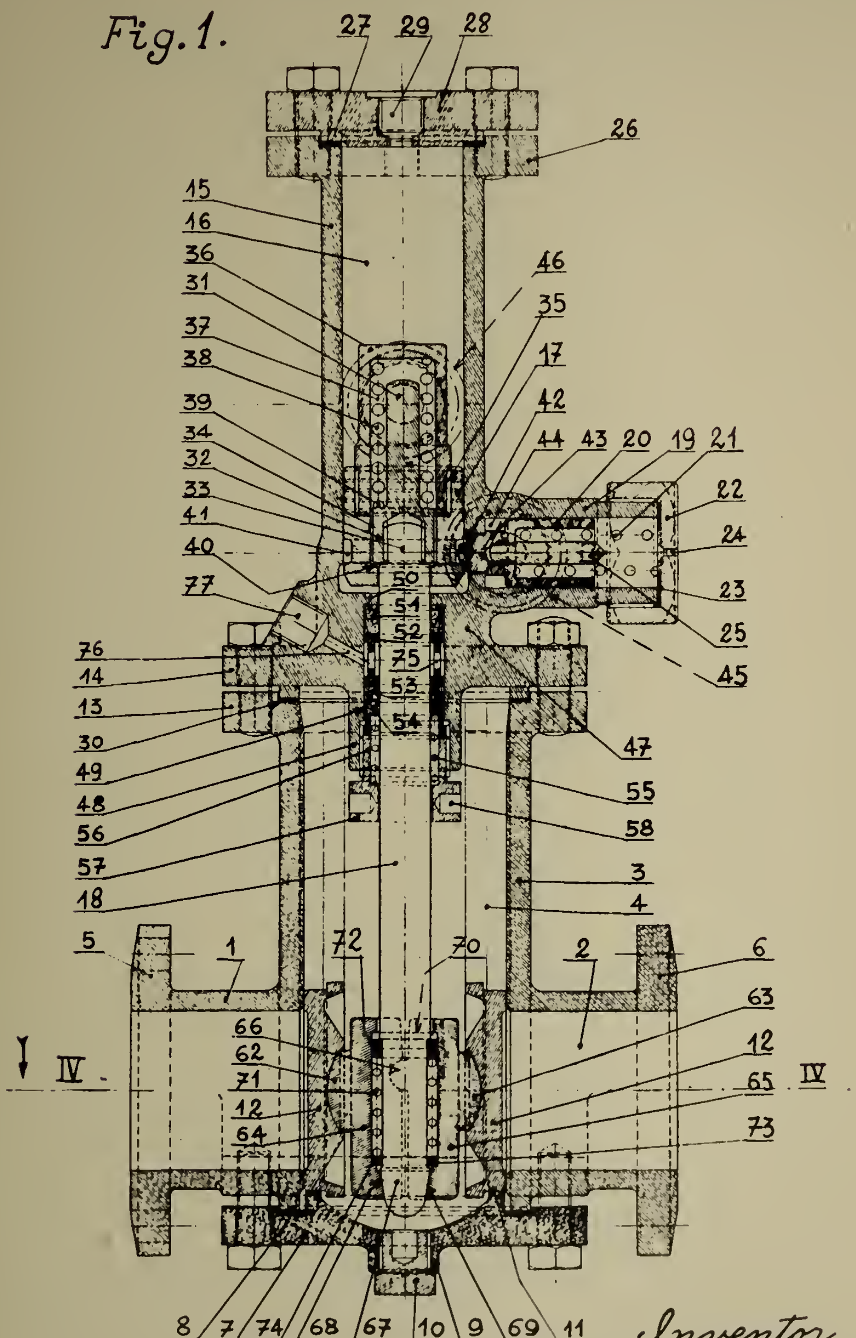

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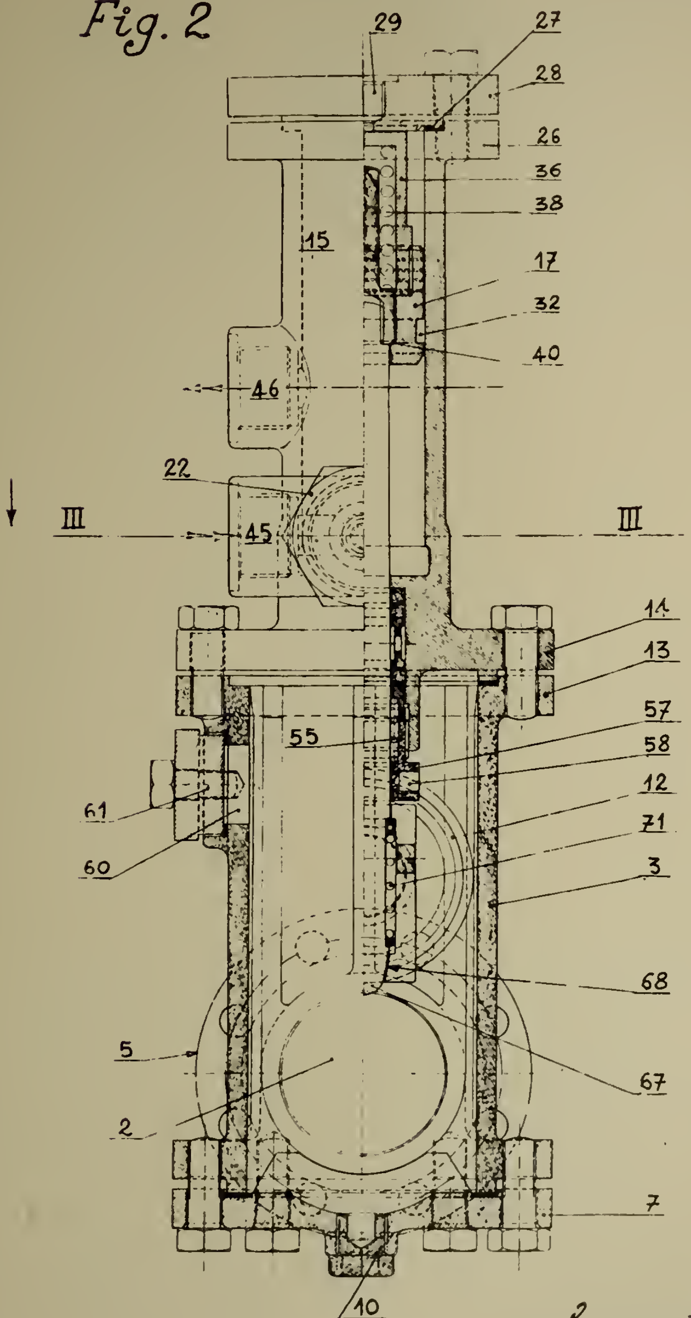
Fig. 2



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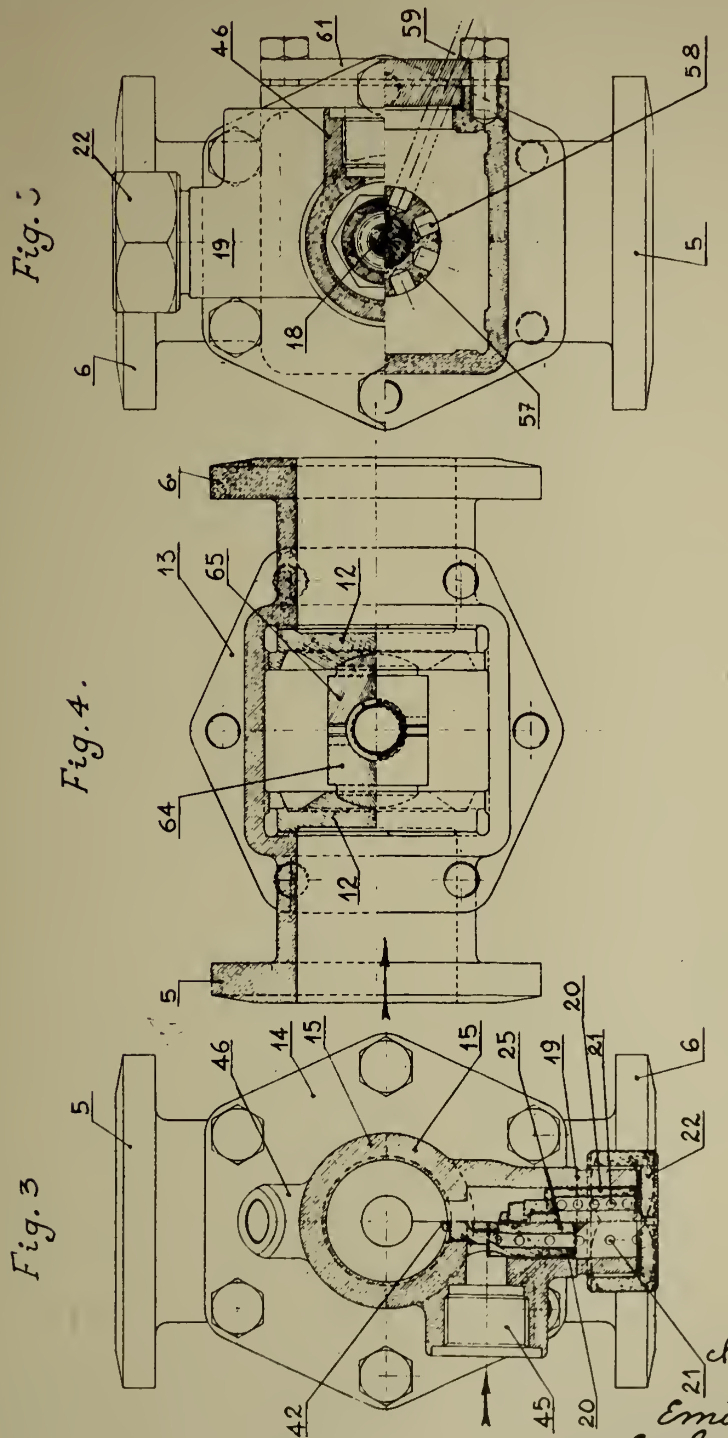

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ALIEN PROPERTY CUSTODIAN

HYDRAULIC TORQUE CONVERTERS

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Application filed June 18, 1941

Our invention relates to hydraulic torque converters and has special reference to converters of this kind as they are used in connection with internal combustion engines because of their favourable adaptability to the turning moment over a certain portion of the transmissions. They are also made use of in connection with mechanical change speed gears when it is necessary for the transmission to cover a large area of secondary numbers of revolutions, as for example in the driving mechanism of rail cars.

A main disadvantage with hydraulic torque converters in such mechanisms is the circumstance that the disengagement and re-engagement of the transmission can only be perfected slowly or by means of additional devices and with shocks. As the emptying and filling in spite of all expediting steps (increase of the emptying cross section and of the filling pumps) lasts at least several seconds and as an interruption in transmission for such a long period is not admissable, it became necessary to provide special friction clutches in addition to the hydraulic power transmission allowing for these to remain filled while the friction clutches are disengaged. The dimension and the weight of such clutches are extraordinary in connection with high performances, their mounting is difficult and they afford adequate large operating devices.

The greatest disadvantage of such friction clutches connected to hydraulic transmissions is that the centrifugal forces of the rotating parts of the friction clutch and of the hydraulic transmission make the engagement of the clutch difficult. They cause great shocks when starting (engagement of the clutch) and when changing in speed, such shocks being not only disagreeable in vehicles but again causing great wear, especially if the vehicle with great performance has to be driven with low speed, for example when towing or shifting other cars. If, for instance, a rail car starts which has a transmission with a friction clutch situated behind a hydraulic torque converter a heavy shock will occur when the clutch half in connection with the rotating secondary part of the converter gets into engagement with the driving device for the wheels which is still at rest. Similar difficulties will occur in connection with transmissions having a plurality of hydraulic torque converters or having gear transmission in addition when changing from one speed to another.

These disadvantages are avoided by our invention which allows only for a very short interruption and an immediate re-engagement of the transmission without shocks.

For this purpose, according to our invention, means are provided for shifting the turbine wheel of the hydraulic converter out of the hydraulic circulation thus causing its separation from the working transmission.

By our invention we do not intend to increase the efficiency of the transmission; the turbine wheel is only shifted for the purpose of separating the secondary part out of circulation of the hydraulic converter. As this state of separation is only short in time it does not matter that during this period the incoming primary performance, even if it be the maximum output of the motor, is transferred into whirls, shocks and friction inside of the transmission, as it is not a normal state but occurs only when the transmission is interrupted.

According to our invention, we further improve the prevailing conditions by providing means for braking the turbine wheel or reducing its speed of rotation after it has been shifted out of the hydraulic circulation. Thus the speed of rotation of a clutch half which may be situated behind the hydraulic converter and connecting to a mechanical change speed gear is also reduced so that within a short time that speed of rotation is reached which allows for final clutch engagement. Consequently, the time period necessary for a speed change is considerably reduced. Besides, it is not necessary to provide additional devices for quick speed reduction of the driven parts behind the torque converter, which would afford additional space.

It is preferred, according to our invention, to shift the turbine wheel so far towards the wall of the casing that there is only a so small intermediate space that the friction and whirling of the liquid in rotation with the wheel causes its braking; or blades may be provided on the casing wall causing speed reduction of the circulating fluid and consequently also of the wheel itself.

Usually there are holes in the disc of the turbine wheel for the purpose of equalizing the fluid pressure, so that the fluid escaping through the narrow space at the circumference of the turbine wheel is again fed to this wheel, thus causing a pumping effect which results in braking of the wheel. For the purpose of increasing this effect there may be provided channels or gaps in the wall of the housing where it surrounds the turbine wheel when withdrawn for leading the liquid over to the other side of the wheel disc.

Another advantageous construction, according

to our invention, is the provision of friction surfaces on one side of the turbine wheel and on the corresponding inner side of the housing wall.

The current in the hydraulic converter itself continues in the same manner after the turbine wheel was shifted out, the output being received by the hydraulic circuit as before. After shifting in the turbine wheel again, the output is immediately transmitted again by the hydraulic converter. When putting in the turbine wheel there can be no shocks whatsoever owing to differences in the speed of rotation, these being entirely suppressed by the hydraulic effects of the circuit.

The invention may be applied to power transmissions of the purely hydraulic kind as well as to transmissions with hydraulic circuits and change speed gears or to such transmissions in which hydraulic circuits are bridged over by direct coupling.

According to our invention, the blade-rim of the turbine wheel is connected with the driven shaft by a suitable support through the ports of which the pressure in the rooms before and behind this part is equalized so that there are not opposed in these rooms any essential counterpressures to the shifting of the turbine wheel. It is useful to connect the turbine wheel with a pressure-operated cylinder or piston by means of which the turbine wheel may be shifted out of the hydraulic circuit or pushed into it, this latter being its position in the normal service.

According to our invention, there is arranged, furthermore, on the shaft of the turbine wheel a disc or similar part which tightens the shifting room, that is the room into which the turbine wheel is shifted against the circuit rooms of high pressure. By this arrangement it is obtained that particularly the highest pump pressure cannot counter-act to the shifting operation of the turbine wheel. It is advantageous for the turbine wheel to be arranged and designed in such a way as to be forced, preferably by pressure-means, against side-faces of the above-mentioned disc.

When shifting the turbine wheel by pressure-means the operating member connected with the turbine wheel will be designed (in the further development of the invention) as a stepped piston, the surface acting in the direction of engaging being considerably larger than the surface acting in the direction of disengaging, the former having, for instance, double the size of the latter. If there is, therefore, no pressure supplied to the room acting in the direction of disengagement the turbine wheel is kept engaged by itself at any speed of rotation, because the centrifugal force which exists in the liquid contained in the room of engaging, creates constantly a pressure in the direction of engaging the turbine wheel.

In a further development of the invention, the turbine wheel is connected at its smallest rim diameter with a ring by which the pump wheel is locked up outwards in the disengaged position of the turbine wheel. This arrangement offers advantages in certain cases because it brings about that there are fewer whirls in the hydraulic circuit when the turbine wheel is disengaged.

Having given a general description of our invention we now want to point it out more in detail having reference to the drawings which represent several examples embodying our invention.

In the drawings Fig. 1 is a diagrammatic example, mostly in longitudinal section, of a hydraulic torque converter, the shifting mechanism for the turbine wheel being indicated by a hand lever. Figs. 2, 3 and 4 show other examples in which the turbine wheel is shifted by pressure means. Fig. 5 is also a longitudinal section of a hydraulic torque converter with additional other designs; whereas Fig. 6 represents a partial section of another design.

In Fig. 1 mean: 1 the primary shaft 2, the secondary shaft of a hydraulic torque converter. 3 is a roller bearing carrying both the shafts. 4 is a pump wheel, 5 the turbine wheel, 6 the guide apparatus of the converter with the guide blades 7. 8 is a pipe bend, adjacent to the casing part 9, in the hub 10 which is carried the hub 11 of the turbine wheel 5. 12 is a disc connecting the rim of the blades 15 of the turbine wheel 5 with the hub 11. This disc is provided with apertures 17. 13 are splines on the shaft 2 along which by means of keyways and keys 19 arranged in the hub 11, the turbine wheel 5 can be shifted. 20 is a collar of the shaft 2 against which generally the hub 11 leans. 14 is the space between the pump wheel 4 and the disc 12; 16 is the space between the latter and the wall of the casing 9. 18 is a spare room in the guide apparatus. 21 is a circular keyway in the hub 11 operated in the conventional manner by a hand lever 22 by means of a fork 23.

By means of the hand lever 22 the turbine wheel 5 may be shifted from the position of normal operation as shown in Fig. 1, into the dotted line position, the turbine wheel remaining connected by means of the keys 13 and 19 with the shaft 2.

During the displacement the liquid contained in the space 16 is allowed to enter the space 14 through the apertures 17. After the turbine wheel 5 has been shifted to the dotted line position the hydraulic circuit does no longer transmit the torque to the turbine wheel, whereas the circuit itself is not interrupted as its liquid continues to circulate by means of the pump wheel 4 via the guide apparatus 6, 7. If the position of the fuel supply (not represented) has not been changed, the pump wheel will continue to transform according to its characteristic the input into delivery and pressure. Therefore, the same energy has to be put in as before; but the number of revolutions of the pump wheel may eventually change somewhat. The energy is aniliated by turbulence, percussion and friction (production of heat). The extension of the circuit by means of the space 18 is harmless in general; if necessary, this space can be designed as required.

Before putting into operation such a power transmission, for instance, before starting a car, the power transmission of which is provided with a hydraulic circuit according to Fig. 1, the shaft 1 and consequently the pump wheel 4 is started while the turbine wheel 5 is shifted out (dotted line position) and the fuel supply of the driving engine will be regulated according to the energy required for the start of the vehicle. The pump wheel 4 maintains the circuit according to the energy input. At first, the turbine wheel 5 is out of operation and at rest and just before the car is to start the turbine wheel is shifted into the position shown in Fig. 1 in full lines. Thus the torque is transmitted to the turbine wheel according to the size of the hydraulic torque converter, and the car starts smoothly, the number of revolutions of the shaft 2 and, consequently, the car speed increasing according to resistance.

If the hydraulic torque converter, shown in Fig. 1, is connected to a change speed gear, the turbine 5 can be "disengaged" from the circuit in

the same way before changing over from one speed to another, whereupon the gear change can be effected in the conventional manner. After the gear change the turbine wheel 5 is "re-engaged" by shifting it back into the circuit. During the changing-over operation the driving energy needs no reduction. However, it is also possible to reduce it in the usual way during the changing-over period.

In Fig. 2 mean: 31 the primary shaft, 32 the secondary shaft of a hydraulic torque converter comprising the pump wheel 34, the turbine wheel 35 and the guide apparatus 36 with the guide blades 37 and the bend pipe 38. 39 is a casing adjacent to the bending pipe 38. The turbine wheel 35 can be displaced within the casing. The turbine wheel is connected by means of a disc 42 to a pressure-operated cylinder 43 made up of the cylinder bottom 44, the side walls 45 and the cover 46 and connected at the other hand by means of keys and keyways 47to keys and keyways 48 which are arranged on the driver 49 located immovably and uncapable of being turned on the shaft 32. The driver, in its turn, is surrounded by the casing hub 50 adjoining casing 39.

In the bore of the shaft 31 is arranged a lengthening piece 60 of shaft 32, in the centre of which is situated a tube 61. The circular space 62 between the tube 61 and the portion of shaft 60 as well as the space 63 within the tube 61 permit the pressure supply to the cylinder 43. There are bores 64 and 65 in the portion of shaft 60 connected to the spaces 62 and 63, respectively, and lead to the centre of the cylinder 43, the bores 64 on the left hand and the bores 65 on the right hand of the disc piston 51 connected to the portion of shaft 60. Fitted at the shaft 60 is an intermediate disc-shaped piece 66 at the outer rim of which is provided a tightening surface 69. A similar tightening surface 70 is arranged outside of the disc 42 of the turbine wheel 35.

The turbine wheel 35 is shifted by pressure means, for instance, pressure oil, via the spaces 62 and 63 to the cylinder 43.

When the turbine wheel 35 is in the engaged position as shown in the lower part of Fig. 2 the cylinder 43 and consequently the turbine wheel 35 can be shifted to the right by admitting pressure oil through the middle space 63 of the tube 61 and the bores 65 into the space on the right hand of the piston 51 so that the turbine wheel is shifted into the disengaged position as shown in the upper part of Fig. 2. On the other hand, by directing pressure oil through the circular space 62 between the tube 61 and the portion of shaft 60 and via the bores 64 to the space on the left hand of the piston 51, the turbine wheel 35 can be shifted back from its disengaged position into the circuit so that power is transmitted again to the turbine wheel in the conventional manner.

During the engaged position of the turbine wheel both the surfaces 69 and 70 are in touch and are kept in this position by means of the pressure oil fed to the space on the left hand of the solid piston 51. The interval between the pump wheel 34 and the turbine wheel 35 where exists a high pressure has no outside connection. Consequently, no high pressure can enter the space between the discs 42 and 66.

The result of the displacement of the turbine wheel 35 is the same as that in our example given in Fig. 1.

The joints conveniently provided in this arrangement are indicated in Fig. 2 between the different parts the object of which can easily be taken from the illustration.

The example of Fig. 3 is similar to that of Fig. 2. Here, too, is provided an intermediate piece 66 fitted with a tightening surface separating the spaces of high pressure. The blade rim 80 of the turbine wheel 81 is provided with an angle ring 82, 83 situated during normal operation in the space 85 of the middle part 84 of the torque converter. When the turbine wheel is shifted outwards the pump wheel 34 is separated at the outer periphery by the angle leg surface 82 running in the direction of periphery of the angle rim. Thus the supply of the circuit is interrupted.

In the example shown in Fig. 4 the turbine wheel 105 is joining a ring 106 which is connected by means of the disc 112 to a stepped piston 111. The latter can be shifted in the cylinder 103 which is connected to the secondary shaft 102 in a way that it cannot be turned or shifted. 101 is the primary shaft, 104 the pump wheel. Hub part 114 of the stepped piston 111 can be shifted in the hub bore 115 arranged at the intermediate piece 116. Rotor 105 is equipped at its external periphery with keys and keyways 123 which can be shifted in the corresponding keys and keyways 124 of the guide part 103. 125 and 126 indicate the efficient surfaces of the stepped piston 111; 127 and 128 are the pressure means spaces of the cylinder 103. In the bore of the shaft 101 is situated a portion of shaft 160 forming an extension of shaft 102 to the left and is carried in a roller bearing of shaft 101. In the bore of the portion of shaft 160 is situated the tube 161 the extension of which on the right hand forms a bore 166 in the shaft 102 from which radiate radial bores 165. The space 162 between the portion of shaft 160 and the tube 161 corresponds to the space 62, the bore 163 of the tube 161 corresponds to the bore 63 of Fig. 2. From the circular space 162 radiate bores 164, leading into the middle of the cylinder 103.

In the example of Fig. 4, there is constantly a supply of oil through the bores 163, 166 and 165 without or with a slight overpressure into the space 127. The displacement of the turbine wheel 105 outwards is performed by means of supplying pressure oil through the space 162 and the bores 164 into the space 128 before the surface 126 of the step piston 111. When the oil supply under pression is interrupted the turbine wheel is engaged by the fact that the surface 125 of the step piston 111 in the space 127 is constantly pressure-operated due to the centrifugal force of the liquid in this space. The dimensions of surface 125 of the step piston 111 ensure that turbine wheel 105 is kept in its engaged position in the circuit at every speed of rotation.

Fig. 5 shows: 201 the primary shaft, 202 the secondary shaft of the converter. 203 is a roller bearing carrying both the shafts. 204 is a pump wheel, 205 the turbine wheel, 206 the guide apparatus of the converter. 208 is a bend pipe joining the guide apparatus and adjacent to the casing part 209 in the hub 210 of which is carried a driver 211 arranged on the shaft 202 in a way that it cannot be turned or shifted. 213 is the disc connecting the rim of the turbine wheel 205 with the hub 214. The driver 211 and the cylinder 224 connected to the disc 213 are coupled by means of dogs or teeth 215, 216 for rotation, however, in a way that the turbine wheel 205 can be shifted in the direction of the axis. The disc 213 is provided with apertures 217. 218 is the inter-

val between the casing wall 209 and the disc 213.

In the bore of the shaft 201 is located an extension 220 of the shaft 202 in the centre of which is situated a tube 221. The circular space 222 between the tube 221 and the portion of shaft 220 as well as the space 223 within the tube 221 ensure the supply of pressure means to the cylinder 224. In the shaft portion 220 there are arranged the bores 225 and 226 which are connected to the spaces 222 and 223 and lead into the centre of the cylinder 224—the bores 225 on the left hand, the bores 226 to the right hand of the solid piston 231 which is connected to the shaft portion 220. Fixed to the shaft 220 is a disc-shaped intermediate piece 227 at the external rim of which is provided a joint surface 228. An identical joint surface 229 is arranged on the outside of the disc 213 of the turbine wheel 205.

The displacement of the turbine wheel 205 is effected by supplying pressure means, for instance oil pressure, via the spaces 222 and 223 to the cylinder 224. When the turbine wheel 205 is in the engaged position as shown in the lower part of Fig. 5, the cylinder 224 and consequently the turbine wheel 205 can be shifted to the right by supplying pressure oil through the space 223 and the bores 226 to the space on the right hand of the piston 231 so that the turbine wheel 205 is shifted into the position as shown in the upper part of Fig. 5 in which it is withdrawn from the hydraulic circuit of the converter. The circuit itself continues to be maintained. By supplying pressure oil through the circular space 222 and the bores 225 into the space on the left hand of the piston 231, the turbine wheel 205 can be shifted back into the circuit from the disengaged position. 233 is the interval at the external periphery of the turbine wheel 205, 234 the inlet cross section of this wheel, 235 are ducts or gaps.

When disengaged from the circuit, the turbine wheel 205 approaches the wall 209 so close that there is only the interval 218 between the disc 213 and the wall 209. By means of the liquid existing in the interval 218 the number of revolutions of the turbine wheel 205 is quickly reduced due to friction and turbulence. The same process takes place when, as shown in the lower part of Fig. 5, the blades 219 are porvided preventing the liquid existing in the interval 218 to circulate with the disc 213 thus exercising also a braking action on the disc 213. The blades 219 may extend in the radial and the peripheral direction over so large a surface and into the wall 209 as is necessary to attain the desired braking effect.

By means of the apertures 217 provided in the disc 213 the liquid escaping at the external periphery of the turbine wheel 205 via the interval 233 to the right flows again via the interval 218 back to the left and thus in front of the inlet cross section 234 of the turbine wheel. By the arrangement of the apertures 217 a constant circulation of the liquid is ensured by means of the turbine wheel 205.

This pumping effect may be considerably increased if in the wall of the casing 208 ducts or gaps 235 are provided by means of which, the turbine wheel 205 being disengaged, the amount of entering liquid between the blade spaces of the turbine wheel 205 and the interval 218 is increased.

The construction, according to our invention, is partcularly important with change speed gears arranged behind the hydraulic torque converter in order to delay the turbine wheel-connected clutch half in the change speed gear to the engaging speed. But it is equally of importance in case of purely hydraulic transmissions (without a combination with a mechanical change speed gear).

In the construction shown in Fig. 6 the disc 213 and the casing wall 209 are equipped with braking surfaces 241 and 242. When disengaged the turbine wheel is in the illustrated position so that the braking surfaces 241 and 242 are pressed close together thus effecting the delay of the turbine wheel and of the rotating parts connected to shaft 202, respectively.

Our invention eliminates not only the troublesome and wearisome emptying of the operating liquid of the hydraulic torque converter but combines, furthermore, as shown by the examples, all the advantages of such a converter with those of a friction clutch without showing the difficulties arising in such a combination normally under service conditions.

With hydraulic torque converters, according to our invention, when used in combination with change speed toothed gearings as mostly applied to motor cars, the shiftable turbine wheel design permits of suppressing a special friction clutch otherwise necessary for the operation of the change speed toothed gearing.

We do not want to be limited to the details described or represented in the drawings, as many variations will occur to those skilled in the art without deviating from the scope of our invention.

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Fig.1

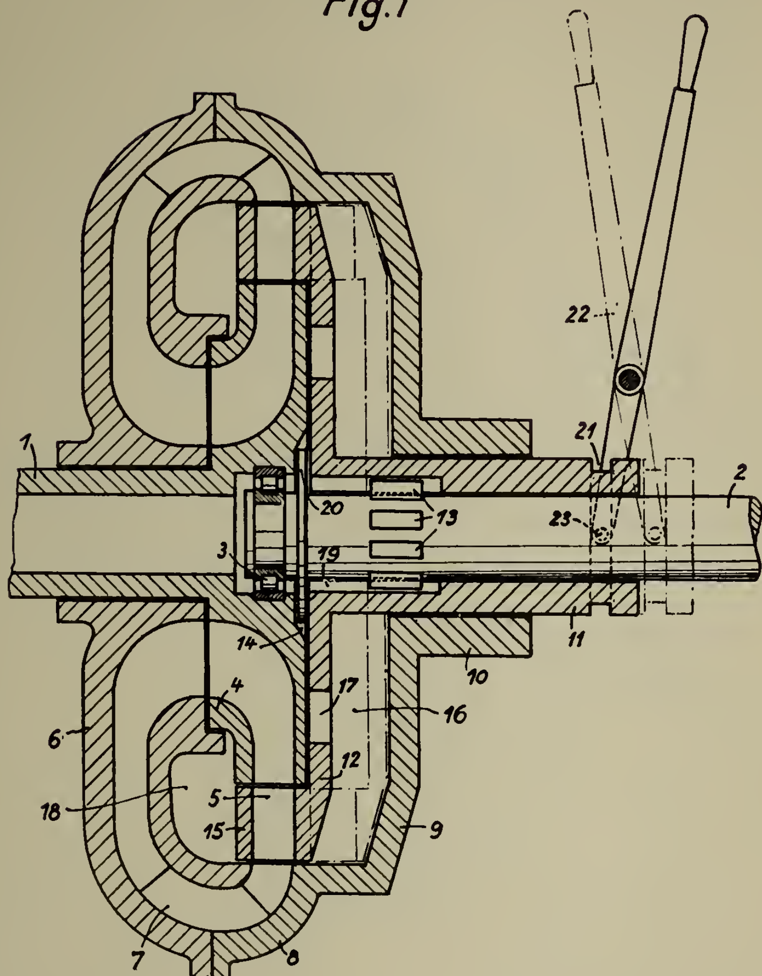

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Fig.2

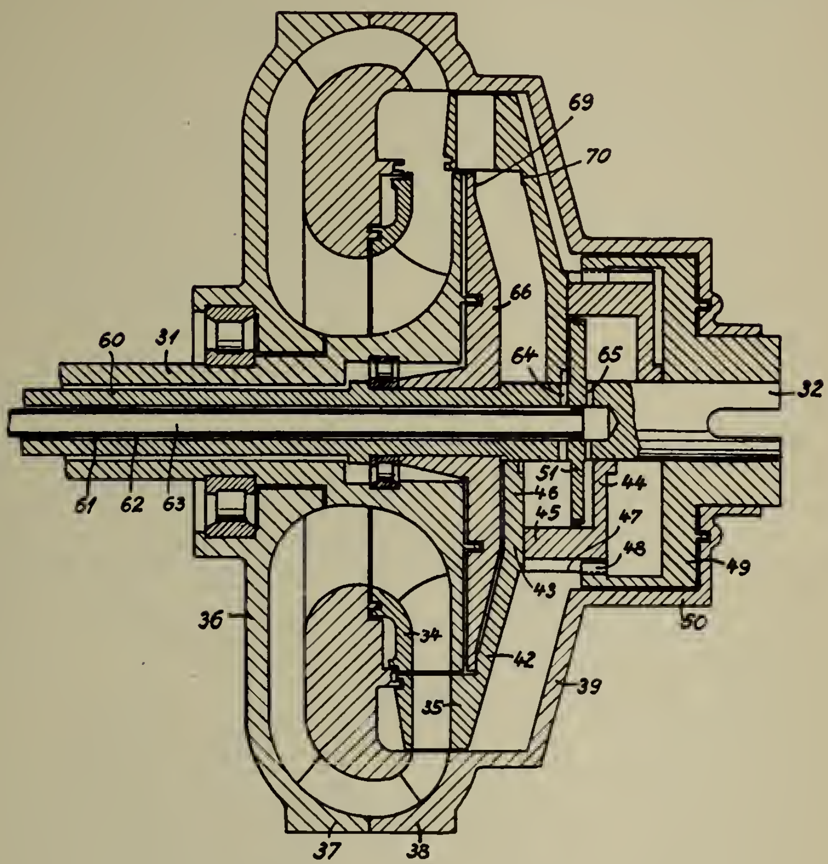

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Fig. 3

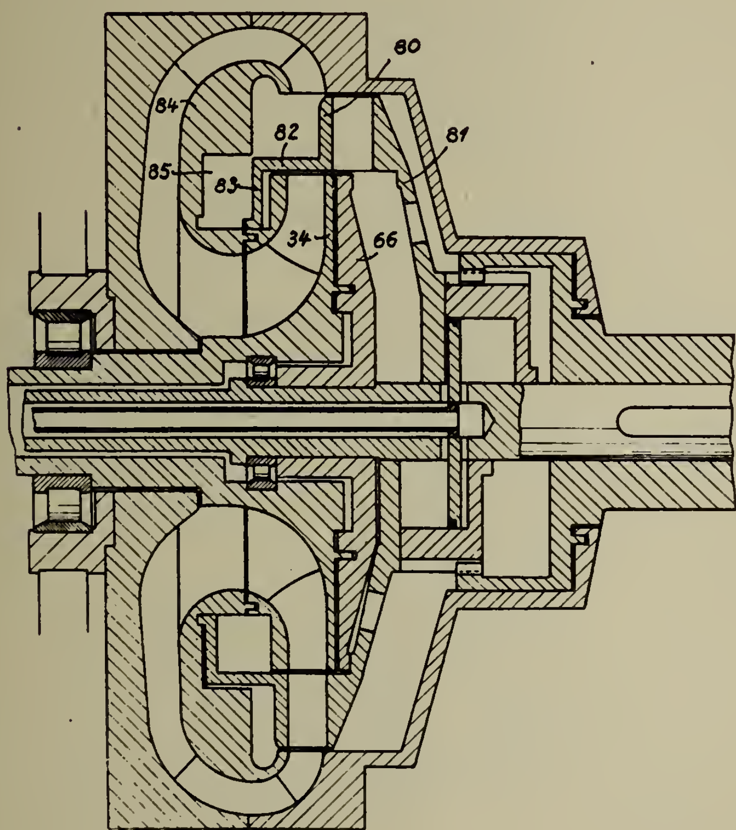

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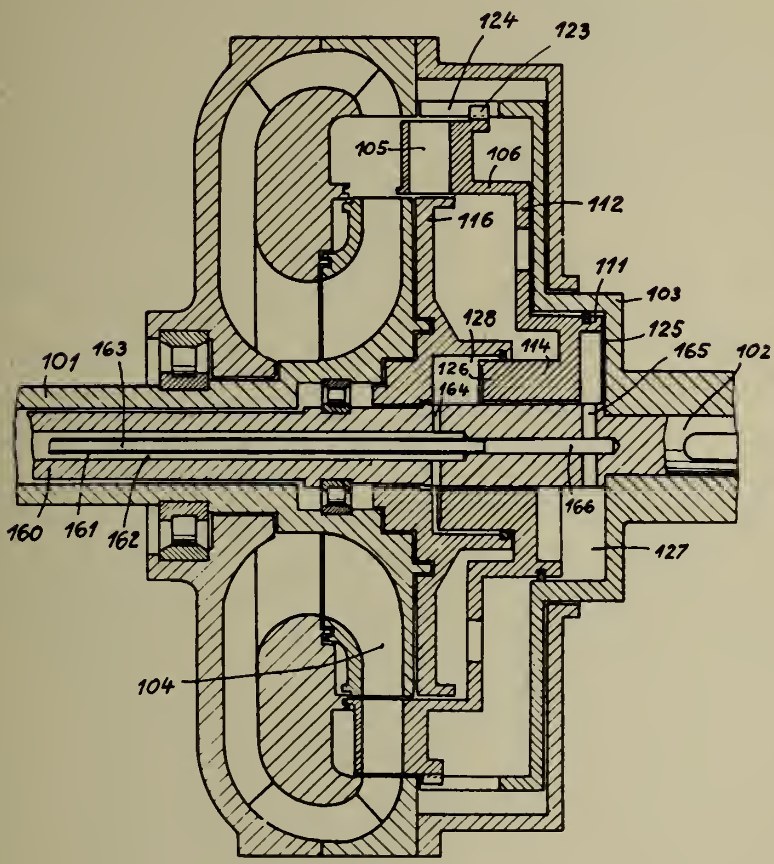
Fig.4



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5 Sheets-Sheet 5

Fig. 6

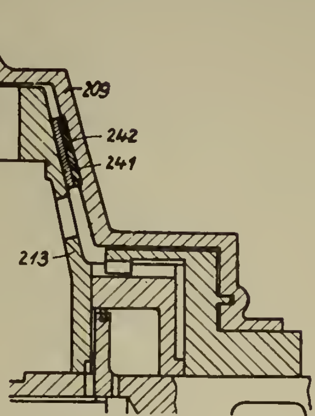
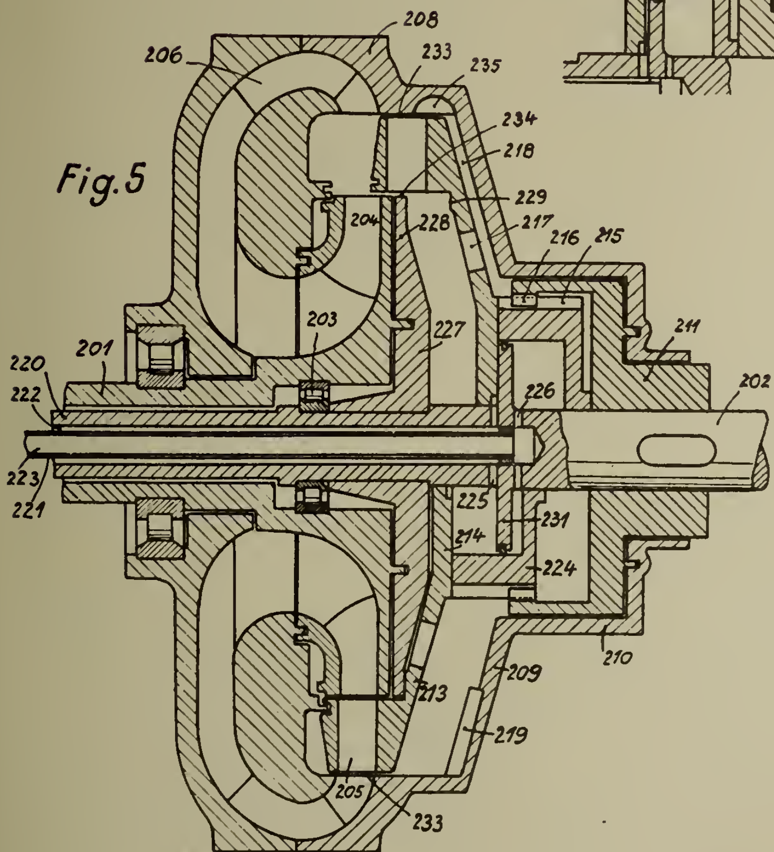


Fig. 5



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Published June 1, 1943 Serial No. 398,440

ALIEN PROPERTY CUSTODIAN

PROTECTIVE RAILINGS

Jan Pekar, Prague, Bohemia and Moravia; vested in the Alien Property Custodian

Application filed June 17, 1941

This invention relates to a protective railing for dangerous road sections.

Railings of the usual type comprising a structure formed of stone uprights connected by iron or concrete beams are unsatisfactory, particularly in case of accidents involving motor vehicles, and it frequently happens that both the uprights and the beams are turned over and fail to prevent such vehicles from being thrown from the road.

It is the object of the invention to provide a protective railing which will keep a motor vehicle on the road in case of accident and afford the added advantage of pushing back the vehicle without overturning or otherwise damaging it.

The feature of the invention resides in arranging along the dangerous part of a road a strong sheet iron wall supported by triangular beams which possess projecting front members having extended portions embedded in a concrete foundation and the rear portion of which has a head member through which a steel bar passes which is held in position by suitable supports sunk into the road bed.

The steel bars passing through the heads of the beams are provided with screws to form a unitary structure with the beams and supports extending into the road foundation the ends of which are fitted with cross bars to increase their hold in the ground and to keep the beams steady even after repeated shocks.

The railing according to the invention is further provided with repelling means for the vehicle, preferably comprising rubber rollers disposed at some distance from one another between every two beams. Each roller is rotatably mounted on a shaft which passes through the upper stiffening of the sheet metal wall and the lower part of which is positioned in a bearing in the concrete foundation. At the points where the rubber roller projects to the extent of about one-third of its width the sheet iron wall is interrupted, and the ends of the gaps have a slight outward bulge gradually passing toward the side so as to prevent excessive stressing of the rubber roller by impacts. In this way, shocks directed toward the rubber roller are deadened, since a vehicle moving on the wall face is prepared for hitting the rubber roller which then repels it.

Repulsion of the vehicle may also be effected by striking a repelling plate being elastically displaceably arranged in the lower portion of the sheet metal wall. The plate is supported by bows moving on an angle iron secured to the beams, and in the space between the bows and the angle iron springs are provided and mounted on firm pins of the plate, which pass loosely through openings in the rear of the angle iron where they are suitably secured.

One form of the invention showing two modifications of the repelling means is illustrated by way of example in the accompanying drawings, in which

Figure 1 is a side view of a portion of a protective railing according to the invention fitted with a rubber roller;

Fig. 2, a side view of the rubber roller;

Fig. 3, a rear view of the general arrangement;

Fig. 4, a detail view;

Fig. 5, a side view, partly in section, of a railing provided with a repelling plate;

Fig. 6, a section on the line VI—VI, of Fig. 5; and

Fig. 7, a rear view of the general arrangement.

A sheet iron wall **21** is secured to triangular beams whose projecting front portions are sunk into a concrete foundation **23**. Through heads **24** of the beams **22** passes a steel bar **25** secured by screws **26** and held in position by supports **27** whose ends are embedded in the ground and fitted with cross bars **28** for greater stability.

In the construction shown in Figs. 1 to 4 rubber rollers **29** are arranged in spaced relation to one another on a tube **30** through which a shaft **31** passes whose lower end is disposed in a bearing **32** and the upper end of which passes through a stiffening **33** of the wall **21**. At the points **34** where it is interrupted by the rollers **29** the wall **21** has a slight outward bulge, and the lower edge **35** of the wall faces the ground like a channel so as to impart to the wheel of a vehicle striking it the repelling direction.

In the embodiment shown in Figs. 5 to 7 the wall **21** is provided in its lower portion with an opening which with its reinforced and projecting edges **36** forms a guide for the straps **37** which support a repelling plate **38**. An angle iron **39** extending along the entire railing connects all beams **22** and serves also as support for springs **40** pushed over pins **41** of the plate **38**, which pass through the center of the strap **37**.

The strap **37** on the angle member **39** is protected against coming out on the back by a through pin **43** which penetrates both arms of the strap **37** and is supported by the rear wall of the angle iron **39**. The pins **41** are interconnected by a through pin **44**, also supported by the rear wall of the angle member **39**.

The spring arrangements are provided along the entire railing at optional distances from one another.

The advantages afforded by the invention consist not only in keeping a vehicle on, or pushing it into, the road but chiefly in permitting the installation of the railing in closest proximity to the border of the road, so that the useful area of the latter is not reduced.

When a vehicle strikes a repelling plate **38**, the plate is forced back until it impinges upon the projecting edges **36** of the wall **21**. As the next spring device is not compressed, however, the vehicle sliding along the wall **21** after the collision will move in a direction corresponding to that of the road.

The invention is not limited to the construction shown and described, but may be varied in many ways without exceeding its scope.

JAN PEKAR.

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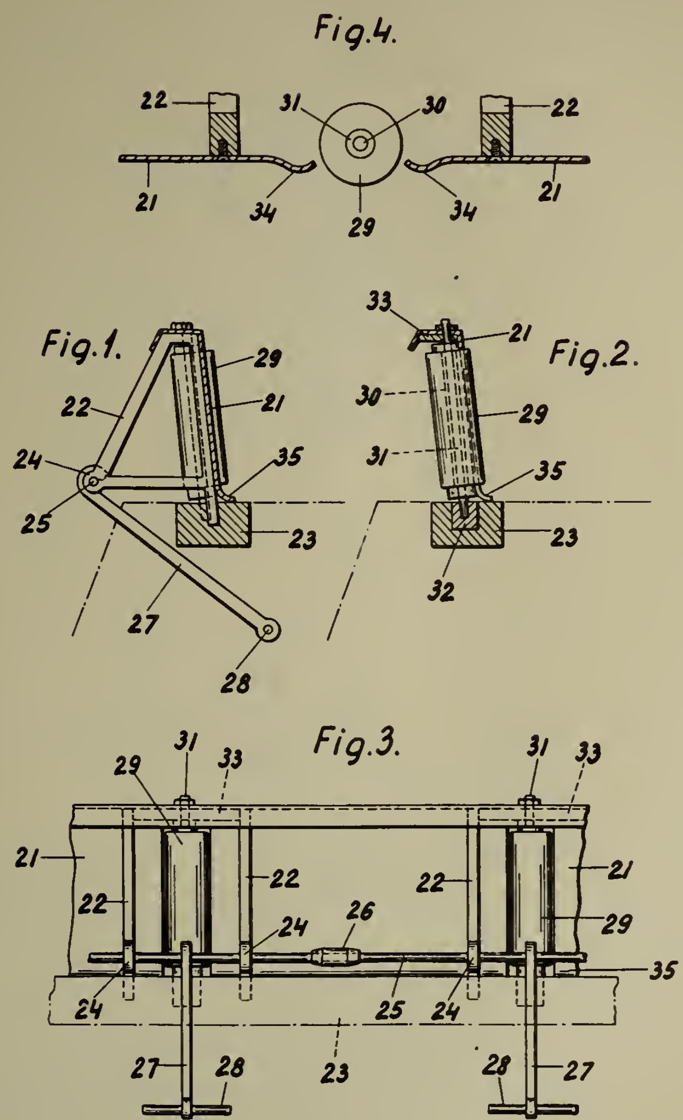
JUNE 1, 1943.	PROTECTIVE RAILINGS	398,440
BY A. P. C.	Filed June 17, 1941	2 Sheets-Sheet 1



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JUNE 1, 1943.	PROTECTIVE RAILINGS	398,440
BY A. P. C.	Filed June 17, 1941	2 Sheets-Sheet 2

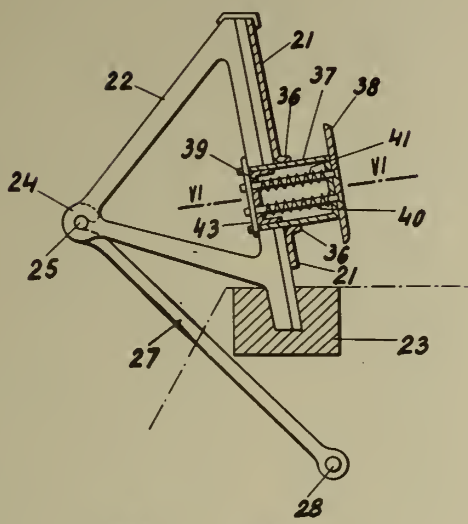

Fig.5.

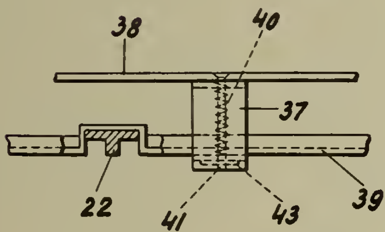

Fig.6.

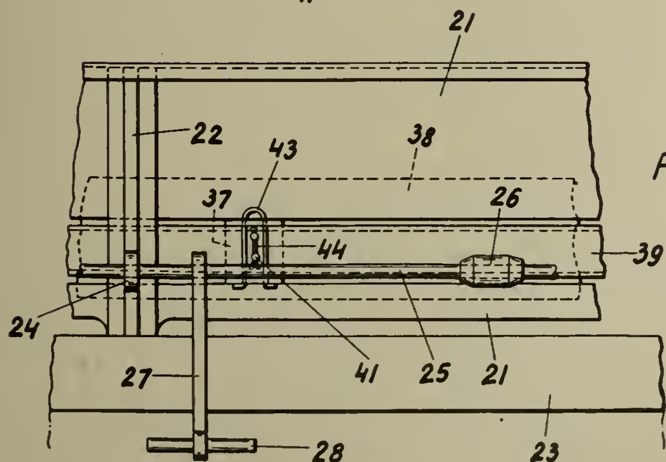

Fig.7.

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ALIEN PROPERTY CUSTODIAN

ANTI-FRICTION BEARING

Walther Bauersfeld, Jena, Germany; vested in the Alien Property Custodian

Application filed June 24, 1941

The material previously resorted to in producing the known types of anti-friction bearings, which are provided with rolls or balls serving as the rolling elements, usually consisted of hardenable steel which, to impart to it a high load capacity, had been subsequently brought to a Brinell hardness of about 650 to 700 by means of a thermal hardening process. After this process the rolling elements same as the bearing elements taking up the rolling elements between them, generally were required to undergo another finishing treatment, i. e., a treatment which on account of the great hardness, could not be applied but by a grinding process. The cost attaching to such bearings is rather high, particularly if the bearings are of a relatively large diameter, the reason being that, to guard against cracking, the cross sections of the hardened bearing parts must have comparatively large dimensions, furthermore, that very much of the material must be ground away on account of the warping to which the bearing parts of larger diameter are subject during hardening, a further reason being that expensive implements are required for carrying out the hardening treatment. Where case hardening is considered adequate for those surfaces which are strained in particular, such as the treads of the bearing parts, cross sections may be kept somewhat smaller and savings made thereby in the cost of material. It must be noted however that treads of bearings produced in that way often tend to develop cracks when subjected to the pressure of rolling elements.

The invention consists in an anti-friction bearing of any optional diameter and whose treads are sufficiently hard without the application of any hardening treatment and whereby the said treads are not subject to the risk of developing cracks, and whereby those parts of bearing surrounding the rolling elements may be made of an ordinary material such as, for instance, of ordinary structural steel, red brass, or the like, which can be easily worked. These advantages can be obtained in that an anti-friction bearing, whose bearing parts in question consist of unhardened material and whose treads consist of parts of the surfaces of hard-drawn steel wires, is so complemented that, as in accordance with the invention, the steel wires are embedded in grooves provided for in said bearing parts and that for the purpose of securing the position of the wires the edges of said grooves are plastically deformed. The invention is not thereby confined to such forms of bearings facilitating a rotatory motion and can be just as well employed where two bodies move rectilinearily relative to one another, such as for instance if, by means of a roller bearing, the table of a planer must carry out a reciprocating movement.

Occasionally, anti-friction bearings for facilitating rotatory movements will be so designed that the grooves run in plane circles. A design of this kind makes it necessary for each of the wires embedded in a groove to be interrupted at a certain point of the bent wire-ends. The interruption in question is of no disadvantage if the interspace between the wire-ends amounts to only a few tenths of a millimeter and if the breaks of the different wire rings are so arranged that they occur at different places on the circumference. The interruptions of the treads can be avoided, however when the grooves run in curves of uniform pitch. The wire then used consists of one piece applied in a plurality of windings. In cylindrical treads the grooves run in the form of a helix line, while in the case of plane treads as occasioned in end journal bearings they run in the form of a spiral. The forms of the treads obviously can also be conical or toric for instance.

The cross sections of the wires in question may be of any optional form. In addition to wires of circular cross section as mostly used it is also possible to use wires of trapezohedral cross section. Considering however that the latter would have to be made to special order it will be advisable to use wires of circular cross section, such as spring wires or wire-strings which can be readily obtained in the market. For practical purposes the diameters of the wires in question range between 2 and 4 millimeters. At such diameters the Brinell hardness of the wires will be in accordance with requirements, since in a good quality of piano wire strings of, say, 3 mm in diameter, the Brinell hardness amounts to about 570. Wires thinner than those have a considerably higher Brinell hardness, while in wires of greater diameter the Brinell hardness is lower. Wires of a diameter smaller than 2 mm are not recommended because of the hardness at such diameters corresponding to that of hardened steel balls, and on account of the surface pressure between the wire and the embedding material being likely to locally increase under the pressure of the rolling elements to an extent occasioning plastic deformations of the embedding body apt to invalidate the bearing or to destroy it altogether.

Theoretical deliberations and practical experiments conformably resulted in the law that, all other conditions being equal, the carrying capacity of the treads of an anti-friction bearing is

proportional to the second power of the Brinell hardness of the bearing parts. The Brinell hardness of ordinary structural steel which is expediently used as embedding material is about 100. Providing the treads of a bearing made of said material with embedded piano wire strings 3 mm in diameter and assuming that, owing to the interruption of the treads between the wires, the carrying surface is reduced by 40 to 50%, an actual rise is obtained in the carrying capacity of the bearing in the proportion of 100^2 to 0.60×570^2 to 0.50×570^2, i. e. from about twenty to sixteen times the load.

Using wires of circular cross section a specially expedient form of bearing is obtained if the width of the wire embedding grooves is equal to the diameter of the wires and their depth about three quarters of said diameter while at the same time giving the bottom areas of the grooves a semi-circular profile. To accentuate the minimum reduction of the carrying surface occasioned by the application of the wires, those parts of the wires protruding from the grooves are recommended to be worked off until the treads show a rectilinear profile.

The method for producing the anti-friction bearings is comparatively simple and therefore inexpensive. On having the bearing body provided with the grooves and the wires inserted, the edges of the grooves can be hand-caulked by means of a center punch where point wise punching is sufficient, or by means of a flat chisel whose cutting edge, which preferably should be blunt, must be held in a position parallel to the wires. Where the bearings are of large diameter, say, of more than one meter, it will be expedient to temporarily fasten the wires on inserting them, i. e., fastening them in points lying five to 10 centimeters apart, while the final fastening is effected when all wires are inserted and temporarily fastened in the aforementioned manner. The wires may also be held in the grooves by applying under high pressure a profiled roll along the edges of the grooves after the wires have been inserted, until the rolled material comes to lie firmly against the wires and thus secures them in position. In the case of the wires having circular cross section, it will be expedient to grind them down in common with the edges of the grooves after the latter have been plastically deformed or, where an essentially smaller carrying surface can be afforded, to so deform the wires by means of a roll or ball adapted to the form of the rolling element, that a carrying surface of sufficiently large size is produced. Yet, apart from the considerably great rolling pressure this method requires owing to the hardness of the wires, the following reasons make this method appear less expedient than the grinding-down process. It has been established that the hardness of the outer layer of the spring steel wires is 30% to 50% less than the hardness of the wire-core. In the case of 3 mm wires the thickness of said outer layer amounts to about four tenths of a millimeter, while in heavier wires it is substantially thicker. Where the desired greater breadth of the tread on the wires is obtained by rolling, the softer outer layer is preserved, while in the grinding-down process applied for the same reason said layer is eliminated, so that the tread resulting in this case will be considerably harder than by the rolling method.

The annexed drawing shows five constructional examples of the invention. Fig. 1 shows the first example: a section of a roller bearing with the load applied at right angles to the axis of rotation. Fig. 2 shows as the second example and in the same representation another constructional form of the bearing according to Fig. 1. In Fig. 3 a third example is given, partly in section, of a bearing with the load applied in the direction of its axis of rotation. Fig. 4 illustrates the fourth example of a roller bearing according to the invention, represented as a section through a guide. The production of the constructional examples is explained by means of Figs. 5 to 7 which are drawn on an enlarged scale, Fig. 5 showing partly in section the development of the roller race, Fig. 6 the finished roller race, while in Fig. 7 another form of producing the roller race is illustrated. Fig. 8 shows the fifth constructional example, a ball bearing with the load applied at right angles to the axis of rotation, drawn partly in section.

In the case of the first example (Fig. 1) a shaft *a* is to be disposed by means of rollers *b* in a bearing bushing *c*. The shaft *a* as well as the bushing *c* are made of non-hardened material. The surfaces of these two bearing parts which are to serve as treads for the rollers *b* are provided with loops *d* of 3 mm piano wire-strings embedded in the grooves of bearing parts *a* and *c*. The grooves run parallel to each other in planes lying at right angles to the rotating axis of the shaft *a*. To secure the position of the wires *d* the edges of the grooves have been plastically deformed. The method employed in doing so is illustrated in Fig. 5, where the bearing parts are provided with grooves *e* which are 3 mm wide and about 225 mm deep and whose bottom surfaces are semi-circular in profile. On having inserted the wire loops *d* into the grooves *e* the edges *f*, which remained standing up when the grooves *e* were produced, are now plastically deformed point by point of the circumference with the aid of a center punch *g* until the wire coils *d* are securely held in place in the grooves *e* as shown in the right hand part of Fig. 5. This having been done the wires protrude beyond the surface of the bearing part to an extent amounting to about one quarter of the diameter of the wires. On having secured all wire loops *d* in the bearing parts, whereby it must be noted that there are small interspaces *h* between the abutting ends of the wires, the protruding parts of the wires are being simultaneously ground down in accordance with Fig. 6, until a carrying surface is obtained with which the rollers *b* are in linear contact.

In the case of the second constructional example (Fig. 2) the grooves *e* are disposed in the shaft *a* and in the bearing bushing *c*. As distinct from the first example, they follow a helix line having a uniform pitch, so that accordingly the inserted wires take the shape of helical springs *i*. To secure the position of the wires the method illustrated in Fig. 7 has been resorted to. Deviating from the method adopted in the first example, a profiled roll *k* is under pressure traced along the edges *f* of the grooves thus rolling and pressing said edges against the windings of the helical spring *i*. On having secured the helical spring *i* in position the protruding parts of the wires are simultaneously ground down according to Fig. 6.

In the third constructional example (Fig. 3) a body *m* is mounted pivotally about a perpendicular axis on a base plate *l*. Conical rolls *n* whose inclination is adopted to that of the treads are serving as rolling bodies. Into the treads grooves are worked running in conical spirals. Windings

of wire *o*, corresponding to those in the first two examples, are placed into and secured in said grooves and are ground down after having been secured. The rolling elements in the fourth example (Fig. 4) are double-cones *p*. The treads of the bearing parts *q* and *r* of a straight slideway have V-shaped profiles. The grooves taking the wires *s* which are inserted and secured in the same manner, run rectilinearily and parallel to the moving direction of the two parts *q* and *r*. After having been secured in the grooves the wires *s* are being jointly ground down same as in the instance of the other examples. There is a drawback in this example in that sliding friction must be overcome in addition to the rolling friction occasioned between the rolling elements and the treads. Said sliding friction is not however occasioned in the remaining examples and can also be avoided in the guide of the fourth example in that the rolling elements are given the form of cylinders. In the fifth example (Fig. 8) the grooves *e*, same as in the first example, are disposed on the shaft *a* and on a two-component bearing bushing *t*, *u*, the grooves being arranged in planes upon which the axis of rotation of the shaft *a* stands perpendicularly, so that the wires *d* inserted into said grooves and secured therein by a previously described method run in planes which lie parallel to each other. Compared with the first and with the remaining examples this bearing differs insofar as balls *v* are used in place of the rollers *b* and of the rolling bodies *n* and *p*. In this case the carrying surfaces of wires *d* are produced through plastic deformation by means of the balls *v*, in that the two parts *t* and *u* of the bearing bushing are brought near each other with the aid of the screws *w* until by rotating the shaft *a* or the bearing bushing a carrying surface of adequate size is brought about on the wires. The letter *z* refers to an adjusting disc.

WALTHER BAUERSFELD.

PUBLISHED

JUNE 1, 1943.

BY A. P. C.

W. BAUERSFELD

ANTI-FRICTION BEARING

Filed June 24, 1941

Serial No.
399,460

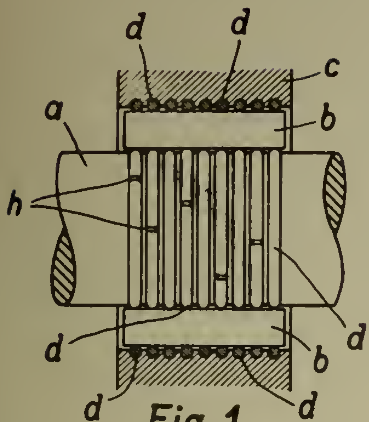

Fig. 1

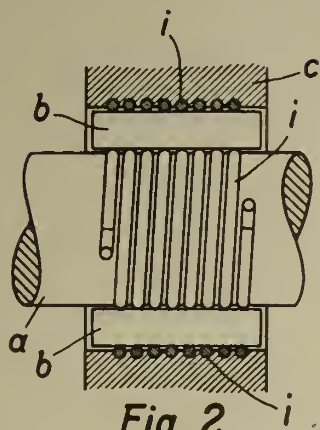

Fig. 2

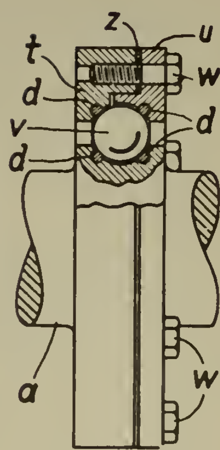

Fig. 8

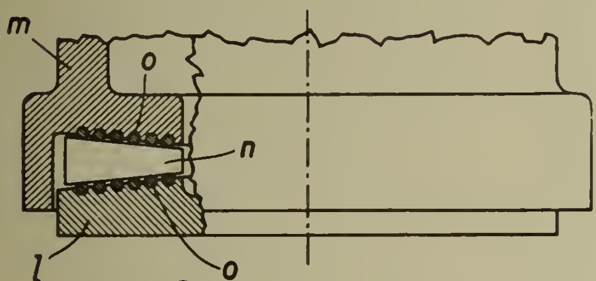

Fig. 3

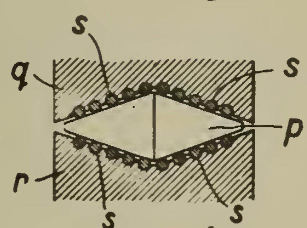

Fig. 4

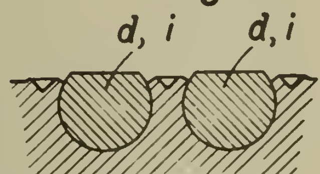

Fig. 6

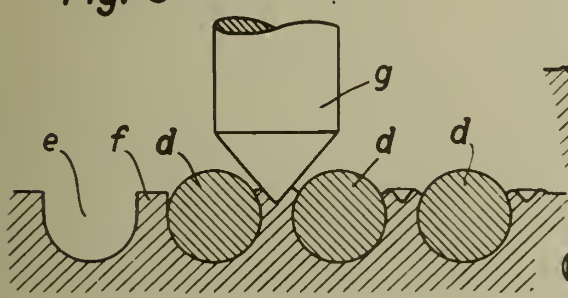

Fig. 5

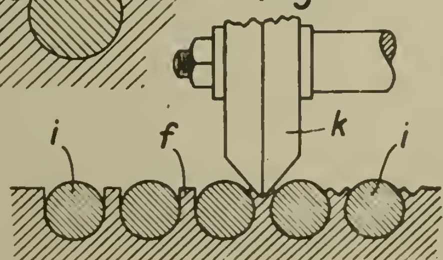

Fig. 7

Inventor:

Walther Bauersfeld

Published June 1, 1943 Serial No. 400,876

ALIEN PROPERTY CUSTODIAN

METHOD FOR MEASURING THE ROUGHNESS OF THE METALLIC SURFACE

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Application filed July 2, 1941

This invention relates to a method for measuring the roughness of a work surface, which is capable of indicating the degrees of the roughness in a more simple and precise way than any of the earlier methods used for shop practice. The gist of this invention lies in that, when the intensity of the angular distribution of light reflected from a metallic surface is measured, it makes an accurate estimate of the degrees of the surface roughness, by measuring a certain range of variations of the intensity of the reflected light to be indicated on the section of the characteristic curve of the intensity of the reflected light that represents exclusively the degrees of the roughness of the work surface.

In the accompanying figures, in which two preferred embodiments of the claimed subject are illustrated:

Fig. 1 and Fig. 2 show rough elevation sketches of the whole apparatus of the two embodiments of this invention.

Fig. 3 is a vertical section of the apparatus shown in Fig. 1 cut by line Y—Y.

Fig. 4 is an enlarged view of the part of the graduated plate shown in Fig. 2.

Fig. 5 is a plane view of the part shown in Fig. 4.

Fig. 6 shows a characteristic curve of the logarithmic variations of the intensity of reflected light as measured by the electric current.

To measure the roughness of a metallic surface is a matter of the utmost importance in discriminating the quality of the finished surface of a work in shop practice. Heretofore, photomicrography, a method of tracing the surface with a needle, and etc. have been applied to this purpose. These methods, however, are practised by means of apparatuses so complex in handling that it was not easy to calculate the degrees of roughness of surface in a simple way, and thus to compare one with others, and to examine them mathematically.

Taking this point into consideration, I have devised a method which, with the application of a method of measuring the intensity of light reflected from the work surface, enables to directly indicate on a gauge the result of measurement as figures representing the degrees of the surface roughness. It is therefore highly effective for examining and discriminating the quality of the finished surface without difficulty at all machine shops.

Now, the novel device of this invention is as follows:

In Figs. 1 and 3,

1 is a projector which projects parallel rays of light for the surface of the work to be tested.

2 is a light-receiving cylinder with a photo-cell which receives only parallel rays of light reflected from the work surface, and is installed at a rectangular position with 1.

3 is an operating lever. By handling this, a set of 1 and 2 is revolved so as the rays of light may be projected for the work surface A from various directions.

These 1, 2, and 3 form an apparatus B which measures the intensity of reflected light from the surface to be tested.

On the other hand, this embodiment of the claimed subject has a milliammeter C, with an alarm bell which is devised to start in ringing when the compass needle of the milliammeter shows a change of a certain range in the strength of the electric current (for instance, a change between 3.68mA and 10mA).

Now, the position of the measuring apparatus B that holds an angle of 3 degrees with the work surface A, is here regarded as the starting position. (The position in which the work surface A holds 45 degrees with the rays of projected light, is regarded as zero.) In this starting position, the regulator D is regulated so as the compass needle of the milliammeter C points to the graduation of 10mA. The measuring apparatus B is then rotated by the operating lever 3, until the milliammeter C registers 3.68mA, which is at once known by the ringing of the alarm bell, as it is devised as to start in ringing when the strength of the electric current changed from 10mA to 3.68mA by a change of the intensity of reflected light from the surface to be tested. The rotation of the apparatus B is then stopped, and the angular degrees of rotation of B is that which indicates the degrees of the roughness of the surface.

In the above-mentioned appliance, the projector 1 of the measuring apparatus B comprises: a source of light 10, a convex lens 11, and a slit 12, so that the light started from 10 proceeds through 11 and 12 in parallel rays to the surface of the work to be tested.

The rays go into a light-receiving cylinder 2 through another convex lens 13 and a slit 14, thus only the parallel rays being received by a photo-cell 15.

The projector 1 is connected with the light-receiving cylinder 2 by a circular-arc slide-lever 16 so as their optical axes intersect at right angles. The slide-lever 16 moves round unrestrictedly on the supporting part 4' of the supporting frame

4 which has, at the intersection of the optical axes of the measuring apparatus B, a window 11 for attaching the surface of the specimen to be tested.

In Figs. 2, 4, and 5, 6 is a slide-indicator which moves along the graduated curved plate 5 attached to the supporting frame 4 of the apparatus B shown in Fig. 1. 7 is an acting-peg which rotates with the revolving body of B, and acts upon the slide-indicator 6. Around this peg is coiled a coil of wire 8 through which runs an electric current for measuring the roughness of the work surface to be tested. The peg has also a spring 9 at its end. And when the electric current is above 3.68mA, the peg is pushed out on the graduated plate, and thus it acts upon the indicator 6; but, when the electric current becomes 3.68mA, the force of the spring makes the peg separate from the graduated plate, and, thereby from the indicator 6, thus leaving the indicator where it is.

Therefore, if we design the measuring apparatus so as to start from the position that holds 3 degrees with the surface of the work to be tested, and rotate it, sending an electric current of 10mA at this position to measure the surface roughness, then the indicated degrees of the indicator 6 that remained on the graduated plate is that which indicates the roughness of the surface of the work. Thus the roughness of the work surface is measured in quite a simple way, and that, without any difficulties.

What is called the degrees of the surface roughness here in this invention, means $1/\beta$ which is the reciprocal of β in the following expression to be shown as a characteristic expression of the electric current as measured by the above-mentioned apparatus B that measures the intensity of the reflected light.

$$I = I_1 e^{-\alpha\theta} + I_2 e^{-\beta\theta} \quad (1)$$

Here, $I_1 e^{-\alpha\theta}$ shows the quality of the ground layer of the surface of the work; $I_2 e^{-\beta\theta}$, the degrees of surface flaws; and θ, angles of rotation of the measuring apparatus B.

The reason why this invention has defined the foregoing $1/\beta$ as the measurement of the degrees of the surface roughness, and why it has adopted the aforementioned contrivance as a method of measuring the roughness of the surface is as follows:

The characteristic curve of the intensity of the reflected light is, as shown in the expression 1, one in which two curves, $I_1 e^{-\alpha\theta}$ and $I_2 e^{-\beta\theta}$, are put together. Of these, $I_1 e^{-\alpha\theta}$ that shows the quality of the ground of the work is not a matter of greatest importance from an industrial point of view, but $I_2 e^{-\beta\theta}$ that shows the degrees of the surface flaws is such that it should be regarded as of the utmost importance in practical surface finishing. To measure β which shows the characteristic of the flaws, therefore, is indeed a matter of the utmost importance in shop practice.

I have therefore defined $1/\beta$, the reciprocal of this β, as the degrees of the surface roughness, and contrived a unique method for measuring this $1/\beta$ in quite a simple way, which greatly facilitates the comparison of the quality of the surface between any two finished surfaces.

Now, while, in the case of the ordinary finished surfaces, the characteristic curve which represents the intensity of the reflected light is seen to curve, when indicated by logarithm, in the neighborhood of zero, it is indicated by a linear charge from somewhere 2 or 3 degrees onwards. And this linear part is that which corresponds to what is indicated by $I_2 e^{-\beta\theta}$. (See the accompanying Fig. 6; in which $I (= I_1 e^{-\alpha\theta} + I_2 e^{-\beta\theta})$ shows the measured values of the work surfaces indicated by the milliammeter C, and the lateral axis θ represents the angles of measurement relative to the work surfaces. The curves M and N show the measured values of such surfaces M' and N' as shown under the respective curves. A long trailed line which indicates only $I_2 e^{-\beta\theta}$ part, as shown in the curve M shows the work surface has deep flaws.)

It is therefore possible to determine β by measuring this linear part indicated by logarithm.

For instance, the difference in measured values of two points on the foregoing line will be shown as:

$$\log I_A - \log I_B = -\beta(\theta_A - \theta_B) \log e$$

Hence,

$$\frac{1}{\beta} = (\theta_B - \theta_A) \frac{\log e}{\log I_A - \log I_B}$$

If, therefore, I_A and I_B are taken such that

$$\frac{I_A}{I_B} = e$$

(for example, $I_A = 10mA$, and $I_B = 3.68mA$), then we have

$$\frac{\log e}{\log I_A - \log I_B} = 1$$

Hence,

$$\frac{1}{\beta} = \theta_B - \theta_A$$

(This result may also be derived by a method other than the above-described one.)

From this, it will be seen that $1/\beta$ will be represented by angular units. Thus, in the above-mentioned example of a preferred embodiment of the claimed subject, I have fixed θ_A, the base-angle of measurement, at 3 degrees; the range of change on the measuring apparatus C, at between 3.68mA and 10 mA; thus enabling to read on the gauge the degrees of roughness of any finished surfaces by measuring $\theta_B - \theta_A$, the angle of rotation of the apparatus B between these two ends.

And this $1/\beta$ which is indicated in this invention as the degrees of roughness of surface, has proved quite suitable in shop practice as a means of measuring the roughness of a work surface.

The measurement of this $1/\beta$ will be possible, too, as is suggested in the above-mentioned statement, by confining $\theta_B - \theta_A$, that is, the angular change of rotation of the measuring apparatus, to a certain definite dimension, whereby reading on the gauge the change of the logarithmic values of the electric current, $\log I_A - \log I_B$.

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E. FUKUSIMA
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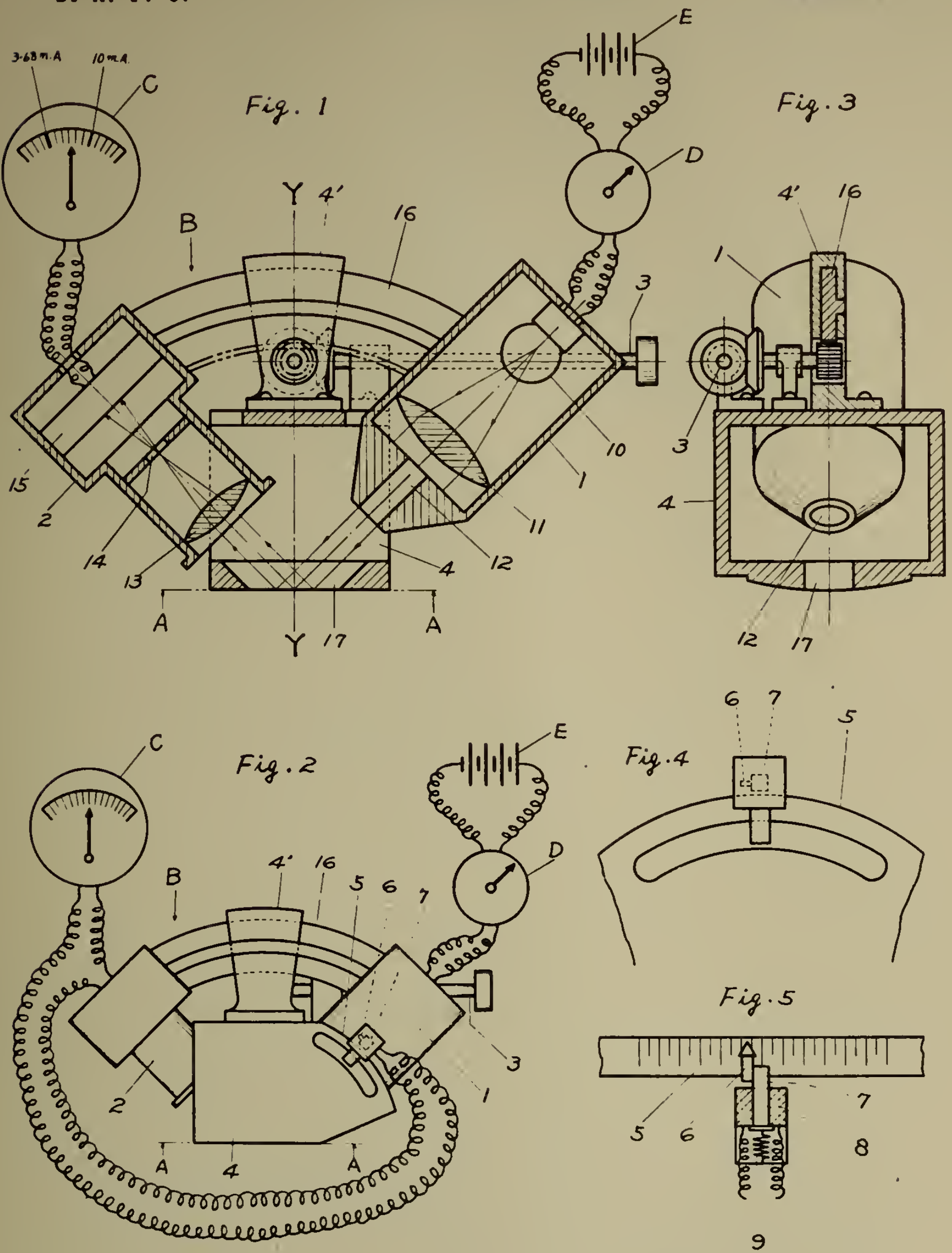

INVENTOR.

BY

ATTORNEYS

E. FUKUSIMA
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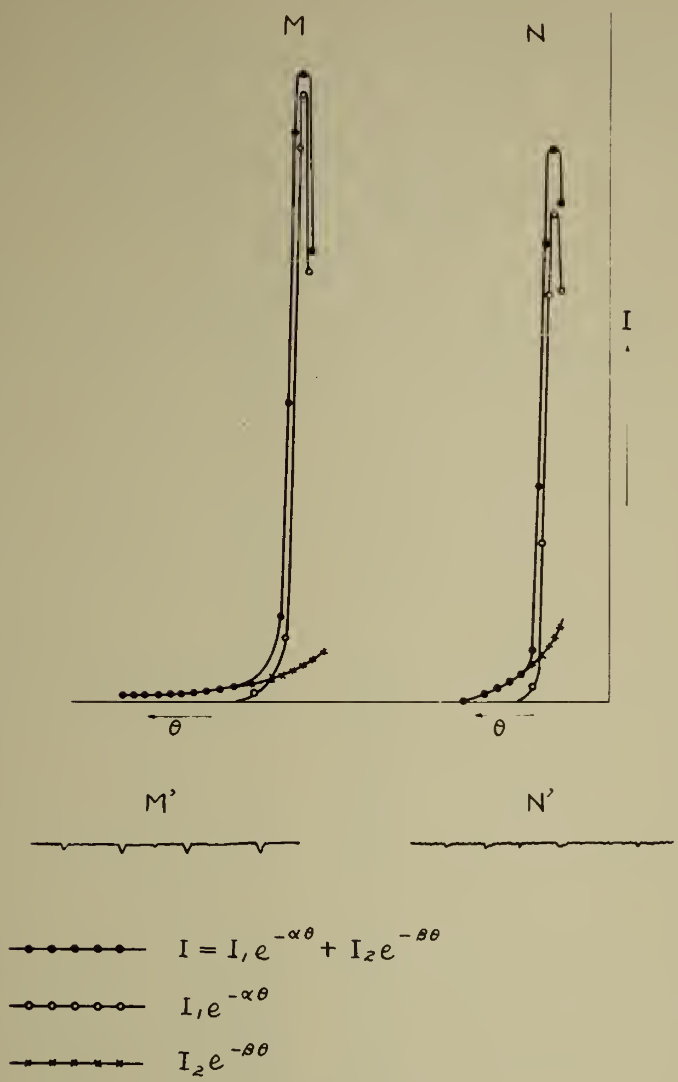
Fig. 6



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ALIEN PROPERTY CUSTODIAN

METHOD OF DIRECTLY PRODUCING PIG IRON AND STEEL

Julius Lohse, Berlin-Wilmersdorf, Germany; vested in the Alien Property Custodian

Application filed July 14, 1941

My present application constitutes a division of my co-pending application Serial No. 363,041 filed October 26th, 1940. The invention disclosed in my present application relates to a method and device for directly producing pig iron and steel from ores, and has for its object to provide improvements according to which a finished product may be made by applying operations that follow one another in a continuous process.

It is known in the art to which my invention appertains, to obtain, within very narrow limits, a certain advantage in the course of the manufacturing process as a whole by providing, for a particular step in the process, a plurality of interconnected rotary furnaces arranged one after another on a common axis to perform some operations under favorable conditions with respect to the utilization of heat. However, as the other phases of the entire process are carried out in the old fashion on hearths disposed in the front or rear of such novel arrangements, these narrowly limited advantages are lost again at the points of transition either by inavoidable cooling effects or old-fashioned working methods.

For example, it is known to desulphurize, dezinc and agglomerate zinciferous iron pyrites in a series of rotary furnaces and at the end of this plant to feed the liquid or pasty metalliferous residue to blast furnaces.

The advantages obtained hereby as to thorough dressing of the material and steady production are, however, partly lost again due to the fact that until the finished product is ready intermittently operating plants of the old type have to be used which are not timed to the steady flow of the preceding unit. Furthermore, in an arrangement of this kind the residue mentioned will necessarily cool down during conveyance to the blast furnace which will therefore be required to make up for the loss of heat involved.

Although it is known during agglomeration of flue dust, fine ores, cement, etc. to adapt the feed of the material to be worked to the working times of the various hearths with the aid of differently shaped and arranged cylindrical rotary kilns, the advantage afforded by this partial measure incorporated with the usual methods is quite slight and subject to the conditions of the subsequent hearths.

The known arrangements are therefore restricted to providing improvements in the preparation of a final product to be completed in plants of the customary type by the interposition of a progressively operating part unit.

The existing arrangement of several cylindrical furnaces of uniform type cannot yield a useful result for the reason that the rotary furnaces provided for each hearth are, from the point of view of thermal economy, disposed in unfavorable mutual relation and fail to insure steadily increasing heating of the material in continuous way in harmony with the continual progress of the treatment. In effect, it just comes to dressing on a long working path which consumes so much heat that the least available for treatment in the subsequent hearths hardly exceeds that required for ordinary sintering. Furthermore, uniform preparation of the melting charge has not been attained notwithstanding the long dressing path.

It is known to preroast and smelt fine charges by blowing them into a stationary or rotary furnace and thereby to better utilize the heat required for dressing. The known arrangements are restricted to finely screened charges and to the use of a screw conveyor for effecting a whirling feed of the fine charge by the low-pressure method, so that in view of the simultaneously supplied fuel, whether oil or coal dust, what is actually happening resembles more a mixing of the material and its dressing agent than a turbulent inter-motion of both. This explains why this blast roasting involves the considerable drawback that owing to the slight turbulence, the cooling action of the furnace wall and the checking of the gas currents due to this effect of the wall a crust will form inside the furnace at some distance from the entrance of the flame. These deposits tend to gradually grow into the cross-sectional area of the furnace to such an extent that finally only a very restricted passage remains which leads from the first blowing zone to the subsequent hearth in the centre of the operating chamber. Blast roasting under the low-pressure method requires therefore bothersome measures to eliminate these drawbacks, and it has been proposed, for instance, to impart to the centrally positioned burners of the blower flames a swinging motion and thereby to direct an oblique heat ray to the wall for removing such crust formed or going to form, by additional heat application.

Even if these defects of known blast roasting methods are removed, there still remains the drawback that all of the heat and the reduction agent can become effective only in connection with finely screened material, and that this heat-consuming low-pressure method leaves no surplus heat for handling also coarser charges fed to the furnace. Coarser material accruing at each grinding operation has therefore either to be re-

ground or, separately from the fine burden, subjected to roasting in the usual furnaces.

My invention eliminates these drawbacks by producing pig iron and steel in a single chamber space and in closely interrelated operations from material prepared by predrying, roasting, sintering, etc., both fine and coarse material being heated and in a reducing flame smelted to form pig iron and slag. While smelting is going on and material accumulates, slag is continually removed and the liquid iron below the skull drawn off in the form of a thin band and, if steel is to be made, fined through an interchangeable converting zone, desulphurized still more and dephosphorized.

By having all operations directly follow one another in the order mentioned and carrying them out in a chamber through which flame heat continuously passes a final effect is insured which is free from losses. According to my invention, each operation in this arrangement is so adjusted and timed to all others that iron may be continuously produced from pretreated coarse and fine charges. From the point of view of both thermal economy and continuous plant operation, one operation is related to the other, so that by the proper adjustment of quantity and speed high quality of the final product is insured. The smelting and refining method according to my invention is initiated by smelting in one or more flames which rotate in a direction oppositely to that of the furnace and thus sweep along the furnace wall, the screened fine stuff being fed to the burner and the coarse material charged directly to the hearth.

The application of a long and continually rotating flame prevents the wall of the furnace from being destroyed by a flame jet having a steady direction and also causes, together with the radiant heat of the furnace, resmelting and removal of caked deposits which tend to be produced centrifugal set up by the rotation of the furnace. Due to the inclination of the furnace, the molten mass slowly moves in the direction of the next operation. In this way, steady discharge of the liquid material is effected without subjecting the furnace wall to excessive stressing in undue form or causing obstructions through cooling and caking deposits. The molten masses accrueing from the furnace walls and the metallic drops produced by the flames are collectors along the deepest line of the incliner furnace and to the thin bath the preheated coarse charge material is directly added, as stated, and is quickly smelting under the triple effect of the action of the flame, heat radiation, and heat transmission from the furnace wall until pig iron and slag are produced in known manner and collected in a special partition.

The liquefied masses continually flowing out of the rotary smelting chamber collect in a subsequent chamber of the rotary furnace plant. Here, the slag is enabled to flow off, and the pig iron is passed in a thin band over a drum until fitted with nozzles where it is blown during its passage and then collects in a connecting rotary refining chamber which may be equipped with special, for instance electric inductive, heating.

From the charge to the finished product the production of pig iron and steel or electric steel proceeds uninterruptedly without heat losses and without requiring interposed conveying operations.

A proposal of the present inventor, which as yet forms no part of prior knowledge, refers to the direct continuous production of copper from sulphide ores by means of one plant comprising a plurality of rotary furnaces serving for preroasting copper ores, a furnace port attached to the preroasters, a rotary roasting drum built onto the furnace port, a rotary nozzle-operated smelting drum, and a rotary heating and refining drum. This plant is applicable merely for continuously roasting and smelting sulphide ores, as stated.

The hitherto described method of producing pig iron and steel or electric steel in one continuous operation is based on proceeding from a pretreated charging material. In further evolution of my invention it is possible to include also the pretreatment of the ores comprising the predrying, roasting, calcining and reducing operations, in the continuous process and thereby to extend the thermal and manufacturing advantages afforded by my process to the necessary preliminary treatment steps enumerated. With this object in view the multi-drum rotary furnace plant on which my process is based is developed so that the interconnected revolving drums are arranged partly in parallel relation and partly on a common axis. The further steps of the process consist in subjecting the ores with the aid of an auxiliary burner in a rotary furnace, to drying, roasting, calcining, then the reduction by the continual addition of coal, conveying the pretreated ores in an uninterrupted stream to the smelting chamber through a closed transition chamber within which any caked portion of the material may be broken up, and then successively smelting it, removing the slag therefrom, refining it, recarburizing it under the action of superheat, and alloying the product if desired. Due to the fact that the heat to be expended for pretreatment in the parallel arranged rotary drum passes through a closed path, particularly in as much as the heat is bound to the solid substances, to the smelting chamber, not only heat losses which otherwise would have to be compensated for within the smelting zone, are avoided but a steady rise in temperature of pig iron is attained, with all the favorable effects upon roasting, calcining, reduction and the rapid dropping out of liquid metal portions from the pretreated ores. In order to separate, at the start, the water vapors developing in the predrying chamber and the carbon dioxide gases produced in the reduction chamber, from the reduced ore, and to prevent them from reacting upon the ore and thus causing reoxidation, provisions are made to remove them at once and to pass them for further utilization of their heat to a waste heat vessel, etc. The arrangement may further be such that below the disintegrator disposed in the closed transition chamber a connecting pipe leads to the coal dust pipe opening into the main burner so as to cause the powdered particles leaving the disintegrator to be directly drawn into the flame by suction effect produced in the main burner. The invention covers also constructional features intended to promote the attainment of optimum results, which features will be disclosed in the following specification.

On the other hand I may use any well-known method for melting the ore charge and causing the molten product to enter a collecting chamber for the removal of the slag, allowing the molten iron to flow into a fining space for a fining treatment, and subjecting it to a further fining treatment if steel is to be made. Although, such a method would not secure all the advantages and favorable results of my present invention, it would

already be a decided improvement on the methods hitherto employed for producing iron and steel.

The invention is illustrated by way of example in the accompanying drawing, in which

Fig. 1 shows an axial longitudinal section of a rotary furnace plant for carrying out the method according to my invention;

Figs. 2 and 3 are cross sections along the lines II—II and III—III, respectively, of Fig. 1;

Fig. 4 shows a rotary furnace plant according to my invention as evolved to include the pretreating steps; and

Fig. 5 is a cross section along the line V—V of Fig. 4.

After previous disintegration of the constituents of a calculated charge to a grain size of 25–30 mm. and screening off the line stuff below 10 mm. the material below 10 mm. is ground in a fine grinding mill, comprising, for instance, a hammer or ring or short tube mill, a blower, air shifter, and motor, to cement fineness and blown to the lateral tube 1 of the burner 2. Having been thoroughly mixed in a burner nozzle 3 with compressed air of 5–6 atmospheres' pressure, and heating oil of 40 atmospheres' pressure, or fuel gas of a pressure of 5–6 atmospheres, the fine material is thrown, for instance, by means of a rapidly revolving worm not shown into the heater 4 running on roller or ball bearings 5 and rotated by means of an electric motor 6. The inside of the rotary jacket 7 of the heater 4 is provided with a highly refractory lining and processes channels like the vanes of a turbine, whereby whirling partial flames are produced each of which passes along the slowly revolving refractory brick lining of the presmelter 8, so that the heat is mainly transmitted by contact, and radiation has only an indirect effect. Both processes produce, however, chemico-physical actions and phenomena within the flame itself, such, for instance, as the escape of water of crystallization, the combustion of the sulphide sulphur to form sulphurous acid, the release of carbonic acid as a result of calcination, the decomposition of carbon monoxide and ash particles, and decomposition of the fuel oil to methane and ethylene, and the reduction of the metals present, since the operation proceeds without excess air. Finally, metal droplets covered by slag form in the flames of the presmelter 8, drop to the inclined bottom thereof and run off.

Simultaneously, the granular material of 30–10 mm. screen size is conveyed from a storage hopper 9 through a pendulum feeder 10 and feeder shovel 11 to a drying and preheating jacket 12 of the presmelter 8, and after dropping into the latter through a wide slot 13, is heated from above and below by the very hot furnace walls and the radiating flames and generally treated in the manner described above, but at the speed of the slowly moving furnace and not at that of the gas stream. The length of the presmelter 8 is adapted to operation at furnace speed, which is facilitated and rendered free from trouble by a regular motor drive 14 and the long flame peculiar to the burner. At the overflow lip of the presmelter 8 the molten masses flow into the second furnace space comprising two sections, viz. a collector and a mixer 15 and a purifying compartment 16, the collector and mixer 15 being of sufficient size and depth to insure sharp, separation of slag and pig iron. The slag floats on top and continually flows over the contracted wall edge of the collector 15 into cars which convey the slag to a waste-dump, though it is also possible to provide in known manner for granulation by air or water. A taphole 17 is provided to permit at its stage a rapid discharge of the pig iron to a bed near the furnace, if a portion of the accruing pig iron is to be sold as pigs. The taphole 17 is of importance also in case of needed repairs to provide for quick removal of the accumulated iron prior to moving the members 15 and 16 by means of the travelling platforms 18*a*, 18*b*. The pig iron which has been thoroughly heated in the collector 15 and thoroughly mixed due to the rotation of the drum driven by a motor 19, gradually rises to a certain level and flows through channels 16*a* preferably of square section and provided in the dam stone partition and leading into the fining compartment 16.

The compartment 16 contains a plurality of stones 20 provided with nozzles and also lipped stones 20*a*. The stones 20 have an inner face corrugated in terrace fashion and an outer bulge, joined together to form a furnace shell, the corrugations and bulges form annular channels which at regular intervals open into a large number of nozzle holes 21. At the point where the nozzle lining is provided, the outer furnace jacket made of strong boiler plate is correspondingly perforated and on its outside turned and ground over a certain width. This rotary surface machined in the manner described is surrounded by a two-part cast iron wind box 22 provided with stuffing boxes 23 and a supply connection 23*a* for air, air enriched in oxygen, etc. The perforated portion of the outer furnace jacket is covered to the extent of approximately three-fourths of its circumference by a thin resilient steel band 24 which is slightly forced against the rotating furnace jacket underneath by adjustable springs 25. The ring formed by the lipped stones 20*a* closes up the compartment 16 and guides also the pig iron into the third space 26 in which refining occurs.

The metallurgical operations in the fining space 16 are as follows:

The pig iron containing numerous impurities, as sulphur, phosphorus, carbon, and slag inclusions, flows slowly through the square channels 16*a* over the annular channels mentioned, arranged one below the other in terrace fashion, in a uniform thin stream and is subjected from below in known manner to the action of a blast of air rich in oxygen which may be supplied to the tuyeres by a compressor of an oxygen plant, not shown. The sulphur content, partly removed already in the presmelter 8, is now completely eliminated through the action of oxygen, and in the same way phosphorus is removed which escapes in gaseous form. The waste gases are utilized in the usual way in an off-heat vessel. As most finely ground lime powder is also blown into the tuyeres in known manner, calcium sulphide or calcium phosphates are formed. The slag together with the decarburized steel floats to the third furnace space 26 and after an electro-thermal treatment during which the last traces of phosphorus and sulphur are removed is discharged as so-called electric slag through a taphole and filled into cars.

The third or refining furnace space 26 into which the steel decarburized in the fining space 16, flows is rotated by a motor 27 and rests with its sets of rollers and turning means on the travelling platform 18*b*. The travelling platforms 18*a*, 18*b*, are interconnected by a coupling pin, so that in case of repairs to be made on the end walls of the chamber 26 or the electro-thermal

heating system thereof the chamber may be uncoupled and drawn out as far as required. The refining space **26** possesses a strong sheet metal furnace jacket having a silica brick lining **28** laid on a heat insulating support and provided with grooves. On this silica lining **28** are wound several layers of strong copper rope **29**, which are separated from one another by staggered insulating layers. Each copper rope is subdivided into three groups and comprises a plurality of strands made of stronger enamelled copper wires. The ropes represent therefore coils and are connected in layers through embedded copper pins extending through the jacket of the unit **26** to strong copper slip rings **30a**, **30b**, **30c** disposed outside the furnace. Steel briquettes **31** are embedded in a resistance mass **32** which is a poor current conductor, highly refractory and rammed in in sufficient thickness over the copper rope coils. After removal of fastening nuts, the steel briquettes **31** can be easily withdrawn, for repairs or removal, through doors covered with sheet metal. The electric heating system described by way of example represents a high frequency furnace fitted with plated iron cores inserted inside the coils, which is operated at three-phase or alternating current of medium or high frequency. The metal bath is heated from above by the burner gases, from the side by the radiation of the revolving front face of the furnace and from below by the induced bottom currents.

With the aid of this device chemico-metallurgical refining can be performed as in the known induction furnaces with respect to recarburization and the production of alloy steels. Substances required for refining are introduced through a door **33** below which an auxiliary taphole **34** with spout is provided, though a finished charge is usually discharged by turning the furnace from right to left, seen from the front, whereas during the heating and filling turning in the other direction is required, as indicated in Fig. 3. Automatic discharge for pouring, or filling iron molds placed on a casting bogie, is effected for instance by means of a worm **35** built up of highly refractory hollow bricks and inserted in the end wall in the form of an Archimedean spiral. The worm **35** discharges into a conical outlet pipe **36**, also consisting of a refractory material and exchangeably arranged in a waste heat connection **37** which does not participate in the rotation. A flap **38** normally closes up the outlet **36**. The elbow **37** is preferably connected to a waste heat boiler not shown and equipped with induced draft chimney and flue dust catcher. The casting worm **35** and the discharge pipe **36** are subjected to constant uniform heating so as to avoid harmful elongation. The heating of the furnace space **26** by fuel gases and bottom currents effects a perceptible saving in current compared with all types of known electric furnaces, which saving is due to the arrangement of the three furnace spaces in the manner described to form a unitary structure.

The not inconsiderable amounts of waste heat can be utilized in a boiler and a steam turbodynamo, and a yield of one ton of steam per one ton of steel ingots may be safely calculated upon. This quantity of steel suffices to cover the power requirements of the rotating furnace plant including disintegration, burner operation, supplementary oxygen plant, electro-thermal heating and the operation of travelling platforms and cranes.

The rotary furnace plant shown in Figs. 4 and 5 embraces, in addition to the production of pig iron and steel, the pretreatment of the ores.

The upper furnace drum A serves for pretreating the fine and coarse ores, and the lower directly connected drums B, C and D arranged on a common axis are used for obtaining the finished product. The upper and lower drums are connected by a closed transition chamber E. At the upper end of the drum A an auxiliary burner F and a rotating flame divider G are provided, and the upper end of the lower series of drums is fitted with a rotatable and swingable main burner H. Those parts of this furnace plant serving for the direct production of the finished product from pretreated ores have been described already in connection with Figs. 1–3.

The pretreating drum A is supplied with fine ore from the hopper **41** through the burner F and with coarser material from the hopper **42** through the rotating flame divider G. Due to the action of the flame of the auxiliary burner F, the fine and coarse ores pass into the drying, roasting and calcining zone of a chamber **43** integral with, and leading into, a chamber **44** of enlarged diameter, in which a reducing zone is formed. At the point of transition between these two zones **43** and **44** reduction coal is supplied by a device which, as can be particularly clearly seen in Fig. 5 comprises a helical track **60** connected with the outer circumference of the drum A, opening with a radial orifice outside the drum A and, during rotation thereof, passing through a filling receptacle **61**. An opening **62** of the track **60** at the other end lies within the inner wall of the drum A. When the latter revolves in the direction of the arrow, the helical channel **60** on passing through the receptacle **61** picks up reduction coal which, during further rotation of the drum moves through the opposite opening **62** under the ore bed in the drum A, which bed gradually advances from the higher to the lower end of the drum. The length of the reducing chamber **44** is so dimensioned relative to that of the roasting and calcining chamber **43** that a continuous sequence of operations up to the contracted outlet end **45** of the reducing chamber **44** is obtained, the latter opening with interposed sealing means **46**, into a closed chamber E. The chamber E is movably supported on rails **47** and is fitted below with a redisintegrator **48** and a down pipe **49** which communicates with the preheating space of the presmelting furnace B through an annular entering member **50** provided with packing means **50a**. The gases formed in the reduction furnace A and constituting valuable waste heat are guided through a band **51** to the combustion space of a waste heat boiler **52**, and the protective arch **51a** serves for preventing reoxidation of the treated material and insures safe discharge.

The furnace head or port of the drum B supports the main burner H which can be moved so that it will cover the inner wall of the smelting drum B also in axial direction to prevent the formation of deposits. From below the disintegrator **48** a piping **53a** leads to the coal dust supply piping **53** of the burner H, so that the powdery matter produced in the disintegrator **48**, owing to the suction developed in the burner, is directly conveyed in a state of suspension to the flame. The main burner H is secured to the furnace door **54**, capable of being lowered and raised, so as to render the furnace head accessible for repairs. The rotary drum B is driven by a

separate motor **55** and discharges, under the action of the main burner H, the liquid metal from the pretreated ores, which then passes to the lower end and into the first compartment of the two-compartment drum C whence the slag can be rearwardly removed as indicated in the drawing and the collected pig iron is exposed to the blast in the central portion in a thin band before it enters the refining unit D, in which, by superheating and induced currents, the remaining sulphur and phosphorus, through the addition of quicklime, etc., are separated in the form of electric slag, and recarburization and possibly also alloying may take place. The waste gases developed during these steps and also in the compartments B, C, D pass through a hot blast stove **52***a* arranged in front of the waste heat boiler **52**. The parts C and D are separately driven by a three-phase and tilting motor arrangement **59**, **59***a* and mounted on a travelling platform **59***b* which is used during repairs. The tuyere member C is separately exchangeable to permit renewal of the lining.

Continuity of the process can be attained without difficulty by correspondingly dimensioning the chambers A, B, C, D as to length and imparting properly related speeds to them. Instead of being superposed as shown, the pretreating chamber A may also be disposed on the side or in front of the smelting, fining and refining drums axially fitting into one another. In this case, the transition chamber E would remain; though slightly changed in structure.

JULIUS LOHSE.

PUBLISHED

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BY A. P. C.

J. LOHSE

METHOD OF DIRECTLY PRODUCING PIG IRON AND STEEL

Original Filed Oct. 26, 1940

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2 Sheets-Sheet 1

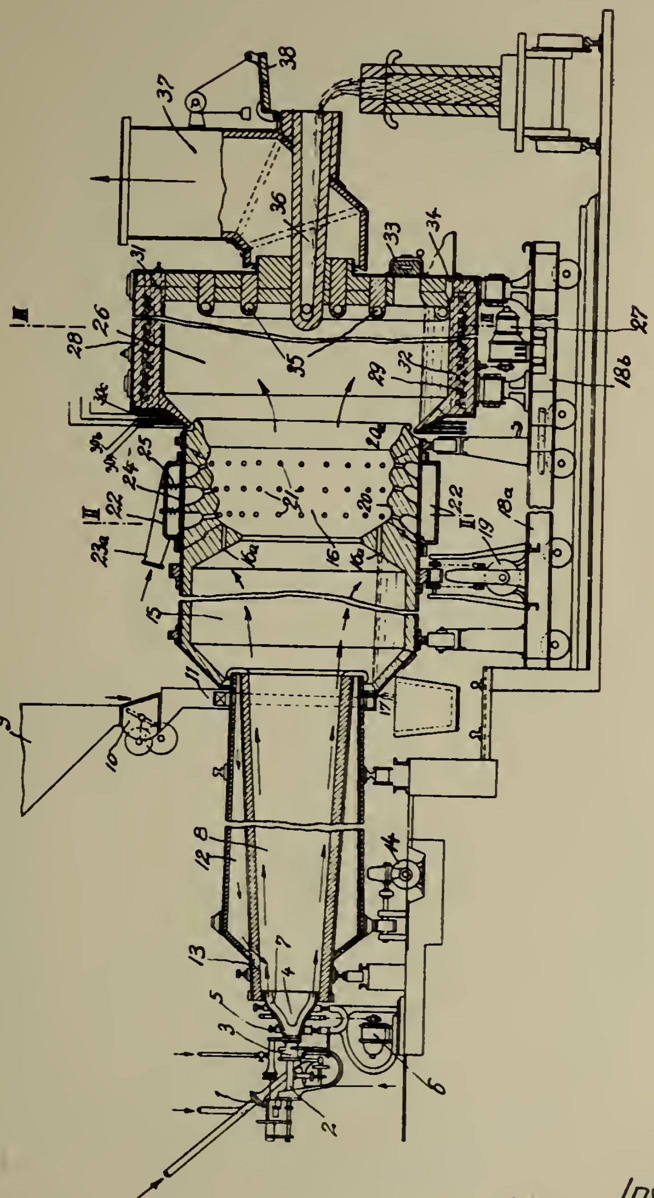

Fig. 1

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Fig. 2

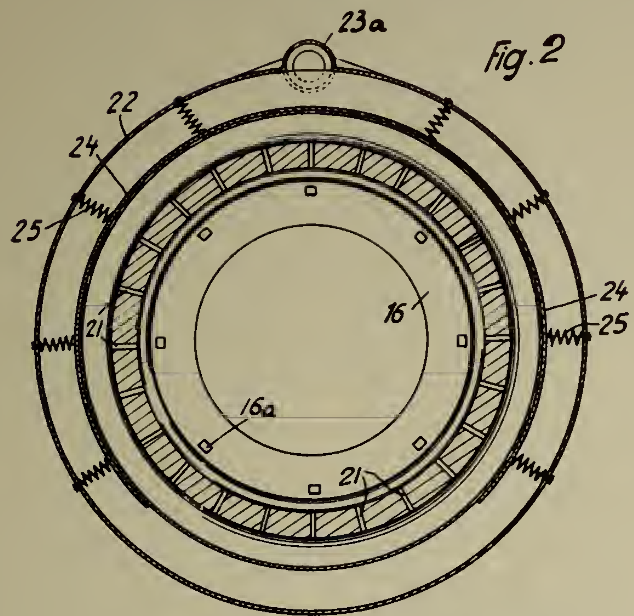
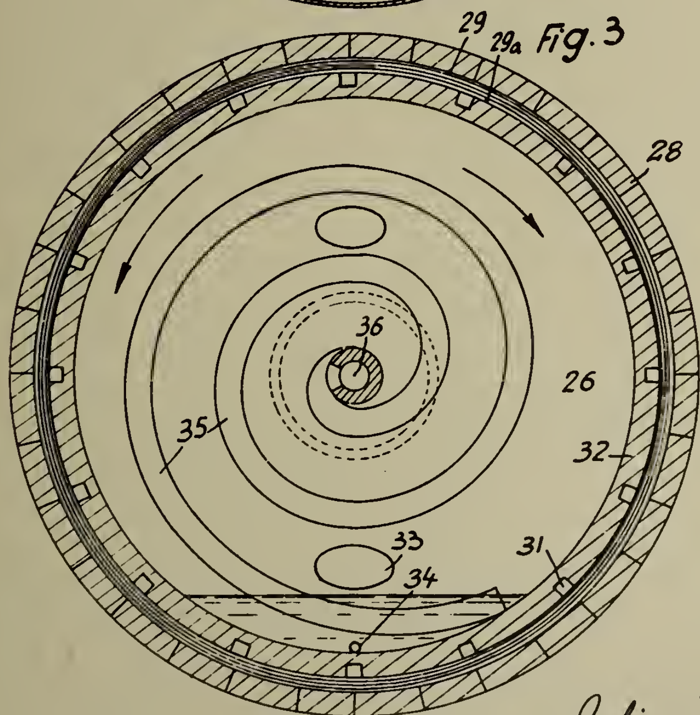


Fig. 3



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ALIEN PROPERTY CUSTODIAN

PRODUCT APPLICABLE FOR TANNING PURPOSES AND METHOD FOR MAKING THE SAME

Charles Coutor, Premery, France; vested in the Alien Property Custodian

No Drawing. Application filed July 14, 1941

This invention has for its chief object to provide a product capable of being used for tanning purposes where it can advantageously replace more particularly butyric acid and lactic acid in all the processes in which the said acids are generally used.

It is well known that butyric and lactic acids are used for tanning purposes in certain processes which comprise an adjustment of the pH of the tanning-liquor, such as, for example, in restoring and in pickling as well as in de-liming operations, the lactate and butyrate of calcium being soluble in water.

I have found that it is possible to use in a similar manner, and for the treatment of hides, a mixture of the water-soluble constituents of wood-tar, the said mixture being in the form of a liquid having a viscosity comprised between 0.2 and 0.5° Engler at 20° C. and a density comprised between 1.050 and 1.130, and distilling between 150° C and 230° C under atmospheric pressure and having an index of saponification comprised between 350 and 500. The said mixture has chemical properties which are at the same time those of fatty acids, of little stable internal or external esters and of the salts of pyridic or quinoleic bases. It gives, with alkaline and alkaline-earth bases, salts which are soluble in water and it possesses a total acidity one half of which is saturated in the cold and the other half at ebullition by the solutions of alkaline carbonates. In a like manner, the acidity which can be dosed with phenolphthalein forms only from 40 to 50% of the acidity which can be used, the latter being given by the index of saponification.

The said mixture of water-soluble constituents of wood-tar can be obtained according to the invention either by starting from wood-tar or from creosote oils, the latter themselves being obtained through a distillation of the tar, or by starting from the pyroligneous liquor resulting from the distillation of wood.

In the first case one proceeds by treating the wood-tar, or the heavy creosote oils resulting from the distillation of the said tar, with water, for instance with 3 to 15 volumes of water, in liquid phase, acetic acid or methyl alcohol or a mixture of acetic acid and methyl alcohol being eventually added to the water, after which the product is separated from its aqueous solution by distillation of the water of the solution or by extracting it with a solvent having a low boiling point and being not miscible with water, as for instance ether, benzene, ethyl acetate, methyl acetate, methyl propionate, light wood-oils, followed by the distillation of the solvent.

The washing water used for washing the tar or the creosote oils dissolves a small quantity of the other constituents of the tar (phenols, phenol esters, carbides and the like) together with the water-soluble constituents of the tar. Since the said other constituents can prove troublesome in tanning, it is generally advisable to remove them from the solution before the latter is concentrated in the above mentioned manner. To this end, the said impurities are removed by a suitable solvent used in convenient proportions: (ether, benzene, ethyl acetate, methyl acetate, methyl propionate, light wood-oils) according to a technique which is known per se and which eventually comprises a final distillation of the solvent.

This solvent also dissolves, together with the impurities, a small quantity of the water-soluble constituents which it is desired to obtain, but the latter can be recovered. In order to effect this recovery, the residue which remains after the distillation of the solvent is added to the tar or to the creosote oils which have not yet been treated.

In the second case the pyroligneous liquor is preferably entirely distilled and subjected to the same process as in the first case, but it is then more particularly advisable to effect the purification through a partial extraction by a solvent before proceeding with the distillation of the water or with the complete extraction of the water-soluble constituents by a solvent.

It is to be noted that, in this second case, the acetic acid of the pyroligneous liquor is generally obtained mixed with the product which it is desired to obtain, but this can be avoided by using, for the extraction, a solvent which dissolves very little acetic acid, such as, for example, benzene, toluene or xylene. Otherwise, it is comparatively easy to separate the acetic acid by distillation, since the said acid has a boiling point of 118° C, while the products which are to be separated go off between 150° C and 230° C.

The pyroligneous liquor can also be treated without being redistilled provided, however, that the main tar has been previously separated by decantation. The mixture so obtained by the treatment of the decanted pyroligneous liquor, as above described for the re-distilled pyroligneous liquor, must be rectified by distillation in vacuo or at atmospheric pressure, in order to separate therefrom, as a product to be collected, the fraction which goes off between 150° C and 250° C under atmospheric pressure, this rectification being practically superfluous when re-distilled pyroligneous liquor has been treated.

In both cases a commercial product is obtained which can be used for tanning purposes.

The fact that the acidity of the components of this mixture is not entirely free but is, for a large part, capable of reacting with substances having a pH of more than 8 allows the mixtures in question to be advantageously used for tanning purposes in the different steps of processing where the pH of the tanning liquors must be adjusted, as, for instance, in restoring, de-liming, pickling,

swelling operations, as well as in tanning in color pits or refreshing.

For these purposes the product according to the invention advantageously replaces butyric and lactic acids, the so obtained leathers having a better feel, a fair grain and a lighter colour with a smell not unlike that of leathers which have been tanned very slowly.

Two cases corresponding, one to the treatment of the tar or of creosote oils, and the other to the treatment of the decanted pyroligneous liquor may be cited by way of non limitative examples of execution of the manufacturing process which also forms a subject matter of the invention.

First example

Hard wood creosote oils going off by distillation between 150° C and 230° C are put through an apparatus of the usual type for the treatment of liquid in counter-current with water at 40° C in the proportion of 7 volumes for 1 volume of oil. Under these conditions the oils remain heavy with respect to the water and about 50% of the oils are recovered as a residue of the washing with water. The washing water is treated in a counter-current apparatus with cold benzene in the proportion of 10% of benzene with respect to the water. The so obtained benzenic extract is distilled for recovering the benzene which is collected below 100° C. The residue, which represents about 10% of the initial oils, is added to the next fraction of creosote oils to be treated.

The so purified washing water is treated in a counter-current apparatus with cold benzene in the proportion of 200% of benzene with respect to the water, the exhausted water is thrown away and the benzenic extract is distilled for recovering the benzene which distils below 100° C. The residue of this distillation constitutes the mixture of the water-soluble substances of the treated creosote oils and represents the commercial product which can be used for tanning purposes.

Second example

Pyroligneous liquor assaying about 10% of acetic acid is distilled. One collects separately, on the one hand, the main products which contain the methyl alcohol and the other products which go off above 100° C and, on the other hand, all the rest of the liquor which distils up to a temperture of 120 to 130° C.

The second fraction of the distilled liquor is treated in a counter-current apparatus with one quarter of volume of ethyl acetate and the extract is distilled to recover, below 100° C, the ethyl acetate, the residue of the distillation being added to the next fraction of pyroligneous liquor to be treated.

The second fraction of the distilled pyroligneous liquor which has been thus partially treated with one quarter of volume of ethyl acetate is then treated in the same conditions with two volumes of ethyl acetate. The aqueous layer which has been separated after this operation is exhausted in dissolved ethyl acetate by a partial distillation and thrown away, while the mixture of products extracted by the ethyl acetate is rectified by distillation in order to separate, first, at about 70° C, the ethyl acetate which will be used for a further operation and, next, between 100 and 118° C, the acetic acid. The residue of the distillation constitutes the mixture of the water-soluble substances which it is desired to obtain and represents the commercial product which can be used for tanning purposes.

CHARLES COUTOR.

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Serial No. 401,909

ALIEN PROPERTY CUSTODIAN

METHODS OF MANUFACTURING SPONGE GLASS ARTICLES AND THE LIKE

Bernard Long, Paris, France; vested in the Alien Property Custodian

Application filed July 11, 1941

This invention refers to methods of manufacturing bricks or other articles used for construction purposes and the like and consisting of multicellular or sponge glass, having a low apparent density and provided with a large number of inner cells or cavities which may be completely empty or filled with a gas.

The present application is a division of my co-pending patent application, Serial No. 265,886, filed April 4, 1939.

Bricks or other construction elements consisting of multicellular or sponge glass are excellent heat and sound insulators. However, the products known heretofore break comparatively easily, particularly since the inner walls extending between the cells are often very thin. There may be other reasons for the fragility of sponge glass elements, such as the fact that it is difficult to anneal them uniformly.

An object of the present invention is the provision of a method of manufacturing multicellular glass articles which are of sturdy structure and are not liable to break easily and which will easily withstand the forces exerted upon them. These new articles may be used for various purposes, such as construction elements.

Other objects of the present invention will appear in the course of the following specification.

Some of the objects of the present invention may be realized by a method of manufacturing an article, such as a construction element, consisting of multicellular glass and containing one or more armatures or reinforcing pieces embedded within the mass of the multicellular glass, each of these armatures or strengthening pieces being so disposed and/or formed that it enables the construction element to resist successfully the various types of forces exerted upon the element.

The armature embedded in the multicellular or sponge glass may consist of metal and may have, for example, the form of an ordinary wire mesh or net capable of withstanding traction forces, or a wire mesh of the type known as "expanded metal." However, many other substances may also be advantageously employed. For example, the armatures or reinforcing pieces may consist of fibres or threads of glass or asbestos which may be woven or braided to form a net.

In accordance with a preferred form of the method of the present invention, a layer of the material used for the production of the multicellular glass which is capable of swelling under the action of heat and/or depression is placed in a mold. The reinforcing element, constituted, for example, by a wire mesh, is placed on this layer before the swelling of the material and in such manner that it is supported by the layer of the material and is free to move vertically with respect to the mold and to follow the displacement of the upper surface of this layer during the swelling of the material. The reinforcing element is then covered by a second layer of the material used for the manufacture of multicellular glass and the whole assembly is subjected to the treatment necessary to cause the swelling of the material and to produce multicellular glass.

The ratio between the thicknesses of the two layers of multicellular glass on each side of the reinforcing element in the finished product is determined by the ratio of the thicknesses of the two layers of the material on each side of the reinforcing element before the swelling. Consequently, the position of the reinforcing element in the finished multicellular glass element is determined by the thicknesses of the two layers of the material placed in the mold before the swelling.

An advantage of this method is that the material during its swelling does not have to pass through the wire mesh or other reinforcing element, as would be the case if the reinforcing element were maintained in a fixed position with respect to the mold. In this latter case the reinforcing element would constitute an obstacle to the swelling of the material.

The method according to the present invention may be carried out advantageously by using as the material which produces multicellular glass, a pulverized mixture of comminuted glass particles and particles of substances capable of developing gases or vapors at the temperature at which the glass particles become soft and capable of being soldered merely by mutual contact.

However any other material capable of producing multicellular glass may be used for the manufacture of reinforced multicellular glass element according to the invention.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawing, showing by way of example preferred embodiments of the inventive idea.

In the drawings:

Figures 1 and 2 are cross-sections through a mold and illustrate the process of manufacturing construction elements in accordance with the present invention, Figure 1 showing the initial stage of the process, while Figure 2 shows its final stage.

Figure 3 is a perspective view of a completed construction element with a part broken off; and

Figure 4 is a section through a construction element of a somewhat different type.

The mold 10 shown in Figures 1 and 2 has inner walls 11 corresponding in size to those of the finished construction piece. In order to manufacture multicellular glass, a pulverized mixture of comminuted glass particles 12 and particles 13

of substances capable of developing gases or vapors at the temperature at which the glass particles are capable of being soldered one to the other, i. e. a temperature of about 800° C. to 900° C., is deposited on the bottom of the mold 10. Then the reinforcing piece 14 constituted for example by a wire mesh or net, is placed upon this layer, which consists of a uniform mixture of the substances 12—13 and is covered by a second layer which also consists of a uniform mixture of the same substances.

Thereupon, the mold and its contents are heated to a temperature of about 800° C. to 900° C., preferably, in a furnace of the usual type; the substances swell and at the same time the glass particles are joined one with the other until finally the brick 16 made of multicellular glass is formed. The reinforcing element 14 may be situated substantially in the middle of the finished brick 16.

In most instances, this is the preferred position of the reinforcing element 14 within the brick 16.

In certain instances, it may be found desirable to place the reinforcing element closer to one or to the other of the outer surfaces of the brick. This may be easily accomplished by placing the reinforcing element 14 within the mixture 12 in the mold 10 at a suitable distance from the bottom of that mold, prior to the heating operation.

In some instances, it may be advisable to place the reinforcing mesh or net 14 on top of the mixture 12 of comminuted glass and gas-developing substances. Then these substances in the course of the swelling rise over the reinforcing mesh or net 14 and cover it.

Figure 4 shows a construction brick 17 consisting of multicellular glass and having a reinforcing wire mesh or net 18 which projects out of the construction element. The brick was manufactured in accordance with the described process; however, the net or mesh 18 originally was placed in such manner within the mold in relation to the comminuted mixture, that after the completion of the brick 17 the mesh 18 still has two ends which emerge out of the surface 19 of the brick. When a number of bricks 17 is assembled for construction purposes, for example, when the bricks are arranged to form the lining of a ceiling, their surfaces 20 and 21 engage each other. The projecting ends of the strengthening element 18 emerge out of the wider surface of the brick, so that they will not interfere with the placing of the bricks and can be used conveniently for the purpose of firmly attaching the bricks to their structural supports.

In certain instances, the reinforcing net 18 or any other strengthening element enclosed in a multicellular glass brick may extend at right angles to the larger main surfaces 19 of the brick 17 instead of extending parallel to these surfaces.

It may be also advantageous to place the strengthening pieces adjacent to the angles of the elements or in zones close to the borders thereof. The reinforcing of such zones may be carried out in addition to the reinforcing of the element as a whole and it is possible to provide several strengthening pieces or net portions in various zones or sections of a single brick.

Whenever a net of woven or braided threads consisting of glass or asbestos fibres is used as an armature for the purpose of strengthening sponge glass, it is necessary that the swelling of sponge glass takes place at a temperature which is sufficiently low to prevent the destruction of the armature.

Obviously, the present invention is applicable to all articles made of multicellular glass, irrespective of their manner of manufacture.

Articles manufactured in accordance with the present invention present several advantages, as compared to prior art.

Due to the provision of the reinforcing pieces, the annealing of multicellular glass is considerably facilitated. The supervision of this operation is rendered much more simple and easy and the output is considerably increased.

Elements made of reinforced multicellular or sponge glass are much stronger than those which are not reinforced, as far as their utilization for construction purposes is concerned. The armatures of these elements may project outside of the elements when the latter are used for wall structure and the like, and may be covered by cement, plaster, or other substances used for connecting the elements one with the other.

Another advantage of articles manufactured in accordance with the present invention is that the use of reinforcing pieces which are embedded in construction elements made of multicellular glass, makes it possible to provide a structure having a great resistance and a high rigidity.

In other words, the provision of reinforcing pieces serves two purposes: In the first place, the reinforcing pieces make it possible to provide elements made of multicellular or sponge glass which individually have a much greater resistance than elements used heretofore. In the second place, elements manufactured in accordance with the present invention may be used directly for the purpose of providing structural assemblies, the component parts of which are connected one with the other in a systematic manner, thus furthering the resistibility of the structure as a whole.

The present invention is applicable to all types of construction elements made of multicellular or sponge glass, such as slabs, blocks, molded decorative elements, panels, ceiling pieces, etc. The elements need not be used solely for architectural purposes, for example, cylindrical shells consisting of reinforced multicellular or sponge glass may form parts of a canalisation piping. Sponge or multicellular glass articles manufactured in accordance with the present invention may be also used for a variety of entirely different purposes, for example, as floats for fishing nets.

It should be noted that the reinforcing pieces, while increasing the cohesion of the sponge glass parts, have the further advantage of maintaining in place fragments of sponge glass in case of breakage.

It is apparent that the specific illustrations shown above have been given by way of illustration and not by way of limitation, and that the structures above described are subject to wide variation and modification without departing from the scope or intent of the invention. The structure, the composition, the arrangement, the number, and the direction of the reinforcing pieces immersed in the mass of sponge glass may vary according to the purpose, the form or any other characteristics of a specific element, in order to obtain in each case the greatest possible reinforcement of zones subjected to the greatest strains, or affording the greatest danger to the preservation of the construction element.

BERNARD LONG.

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B. LONG

METHODS OF MANUFACTURING SPONGE GLASS ARTICLES AND THE LIKE

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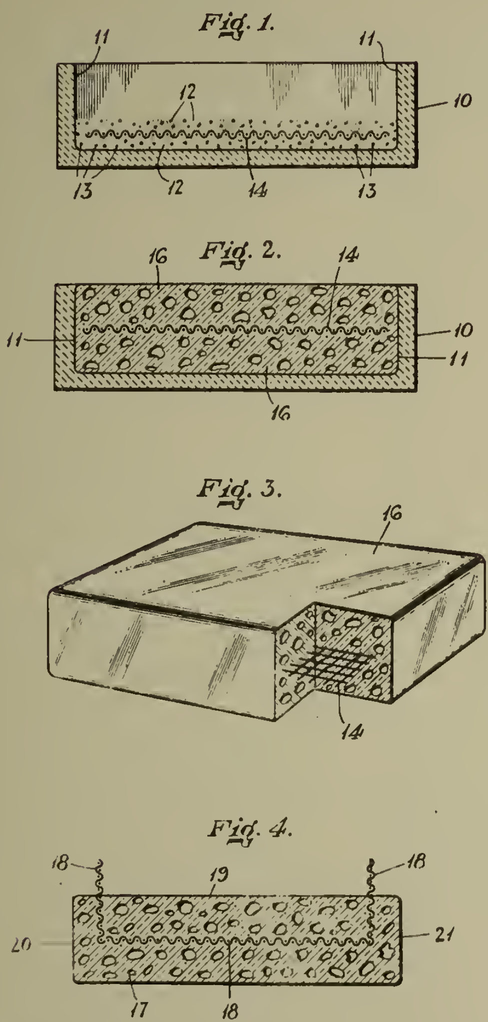

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Serial No. 403,648

ALIEN PROPERTY CUSTODIAN

CARTRIDGES

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Application filed July 23, 1941

The present invention relates to cartridges and more particularly to cartridges for use in gun apparatus which is designed to be employed in relatively inaccessible places, such as a well casing perforator, for example.

This application is a division of an application for Gun perforator, Serial No. 315,157, filed January 23, 1940, which application describes well casing perforating apparatus comprising an assembly of a plurality of similar units each having a plurality of longitudinal powder chambers therein, each communicating with at least one laterally extending gun bore.

It is an object of the present invention to provide a new and improved cartridge for use in well casing perforating apparatus of the above character, which is adapted to comprise a component part of a continuous ignition path extending through the perforating apparatus and including similar cartridges in other units thereof.

Another object of the invention is to provide a new and improved cartridge of the above character in which a charge of powder is adapted to be ignited by electric means connected in an electric circuit extending therethrough and insulated therefrom.

A further object of the invention is to provide a new and improved cartridge of the above character which is adapted to maintain the ignition circuit, of which it forms a part, closed after the charge of powder therein has been ignited.

A still further object of the invention is to provide a new and improved well casing perforator cartridge which is adapted to be ignited by the ignition previously of another cartridge in the same ignition path in the perforating apparatus.

Another object of the invention is to provide a new and improved well casing perforator cartridge of the above character which is adapted to interpose a time delay between the ignition of adjacent cartridges in the same ignition path in the perforating apparatus.

Additional objects and advantages will become apparent from the following detailed description of several representative embodiments, taken in conjunction with the accompanying drawings in which:

Fig. 1 is a view in longitudinal section of one form of cartridge constructed according to the present invention;

Fig. 2 is a view in longitudinal section illustrating a modified form of cartridge, together with electrical means for igniting the same; and

Fig. 3 is a view in longitudinal section illustrating a cartridge of the type shown in Fig. 2, together with mechanical means for igniting the same.

In Fig. 1, the invention is embodied in a cartridge which is adapted to be fired electrically as described in greater detail hereinafter. Referring to Fig. 1, a cartridge **10** is shown which comprises a metallic tubular casing **11**, the lower end of which is internally threaded at **12** to receive the externally threaded portion **13** of a conical closure member **14**. The upper end of the tubular casing **11** is provided with a closure member **15** within which is formed a circular aperture **16**, tapering rearwardly to a restricted portion **17** which communicates with a larger circular recess **18** formed in the rear face of the rear closure member **15**. In order to facilitate the removal of the cartridge **10** from a well casing perforator, a peripheral groove **15**a is provided in the rear portion thereof.

The firing device for the cartridge **10** comprises an enclosed tubular casing **19**, made of a suitable high resistance material, Bakelite, for example, which contains a small quantity of powder **20**. The powder **20** is adapted to be ignited by a wire filament **21** which is connected at one end to a conducting rod **22** and at its other end to a conducting rod **23**. The conducting rod **22** extends through the tubular casing **19** and through an aperture **24** in an ebonite plug **25**, which is snugly fitted against the rear closure member **15**, and into the recess **18**. Secured at the end of the conducting rod **22** is a conical contact member **25**a provided with a threaded portion **26** on which a second contact member **27** is adapted to be screwed.

The contact members **25**a and **27** are maintained out of contact with rear closure member **15** by an insulating disc **28**, disposed between the upper face of the ebonite plug **25** and the lower face of the conical contact member **25**a, and by a ring **29**, of insulating material, which is inserted in the space between the second contact member **27** and the wall bounding the circular recess **18**.

The conducting rod **23** extends through the other end of the casing **19** and through a narrow bore **30** formed in the conical closure member **14**, and it has a pointed end **31** which extends slightly beyond the forward extremity of the conical closure member **14**. A sleeve **32** of insulating material is fitted on the conducting rod **23**, which serves to insulate the latter from the conical closure member **14**.

When the respective units of the well casing perforator, which is described in the aforementioned copending application, are assembled together, at least one continuous ignition path is formed. This ignition path is constituted by a plurality of cartridges like the cartridge 10, which are mounted so that their longitudinal axes coincide. For the sake of simplicity, however, only two cartridges have been shown in Fig. 1 in the positions which they would assume in the assembled perforator. The second cartridge 10′ is identical with the first cartridge 10 and corresponding parts thereof have been designated by primed reference characters.

As indicated in the aforementioned copending application, each ignition circuit is energized by a source of electrical energy at the surface of the earth, one terminal of which is connected to ground and the other terminal of which is connected through a conductor in the supporting cable to the cupper end of the ignition circuit. The lower end of the ignition circuit is grounded to the body of the well casing perforator and the metal casings of the cartridges are likewise connected to ground.

This is illustrated schematically in Fig. 1, in which is shown a source of voltage 33, one terminal of which is connected to ground and the other terminal of which is connected to a conducting rod 34 which is in engagement with the rear contact member 27 on the cartridge 10. The pointed end 31′ of the conducting rod 23′ in the cartridge 10′ is likewise connected to ground, as are the metallic casings 11 and 11′ of the cartridges 10 and 10′, respectively. Also, the igniting filaments 21 and 21′ in the cartridges 10 and 10′, respectively, are adapted to be ignited by different current values, the igniting current for the filament 21′ being lower than that for the filament 21.

In operation, the current supplied by the source of energy 33 is adjusted to give the value required to bring the igniting filament 21′ to red heat, thus igniting the charge of powder 20′ in the casing 19′. When the powder 20′ is ignited, the combustion thereof bursts the casing 19′ and thus transmits ignition to the explosive 35′ present in the cartridge casing 11′.

At the time of the explosion, the ebonite plug 25′ is liquefied by the heat and pressure to which it is subjected and it pushes the insulating disc 28′ towards the rear so as to crush the metal contact member 25*a*′ against the rear closure member 15′. The contact member 27′ is now electrically connected to the rear closure member 15′, which is connected to ground. Since the pointed end 31 of the conducting rod 23 of the cartridge 10 is now connected to ground, the firing circuit remains closed and operative. The current supplied by the source 33 is then adjusted to the value required to bring the filament 21 to red heat, whereupon the operation is essentially as described above in connection with the cartridge 10′.

Fig. 2 illustrates an embodiment of the invention in which the cartridge is adapted to be fired automatically by means actuated by the powder gases produced by the ignition of a preceding cartridge. In Fig. 2, the cartridge 36′ includes a tubular metallic casing 37′ having a thin walled forward portion 38′ forming a main powder chamber 39′, and a thicker walled rear portion 40′ forming an auxiliary chamber 41′ of lesser diameter.

The casing 37′ is closed at its upper end by a transverse partition 42′, in the upper face of which is formed a circular recess 43′, which is adapted to receive a firing pin 44′. The firing pin 44′ is provided with a conical portion 45′ which is adapted to be projected through a small aperture 46′ in the transverse partition 42′ against a metallic cup 47′ inserted in a recess 48′ formed in the transverse partition 42′, which contains a small disc of mercury fulminate 49′ or other similar detonating explosive.

Disposed within the auxiliary chamber 41′ is a hollow tubular member 50′ containing a slow fuse composition 51′ and having an outwardly extending flange 52′ which is screwed within the casing 37′ adjacent the thicker walled rear portion 40′. The tubular member 50′ is externally threaded and it cooperates with the auxiliary chamber 41′ to form a labyrinth-like passage 53′ which communicates with the main chamber 39′ through a plurality of apertures 54′ formed in the flange 52′.

The forward portion of the casing 37′ is internally threaded at 55′ to receive an externally threaded conical plug 56′ having a narrow axial bore 57′ within which is disposed a pin 58′. The forward end of the bore 57′ is normally closed by a thin wall 59′ which is adapted to be pierced by the pin 58′ when the cartridge 36′ is fired.

The firing of a group of cartridges like the cartridge 36′ may be initiated electrically or mechanically as shown in Figs. 2 and 3, respectively. In the electrically fired modification shown in Fig. 2, the first cartridge 36*a* is provided with an igniting filament 60 embedded in a charge of powder 61 contained in a casing 62. The igniting filament 60 is grounded at one end to the metallic casing 37 of the cartridge 36*a* and it is connected at its other end to a conductor 63 which passes through an insulated bushing 64 in the upper closure member 65 of the cartridge 36*a*. The conductor 63 is connected through the conducting rod 34 to one terminal of the source of electrical energy 33, the other end of which is grounded.

When the respective units of the well casing perforator have been assembled as described in the above mentioned copending application, at least one continuous ignition path is formed in the assembled perforator, which path is composed of cartridges like the cartridge 36, the axes of which coincide. Operation is effected by supplying current from the source of electrical energy 33 to the igniting filament 60 in the first cartridge 36*a*. This produces an explosion which forces the pin 58 in the bore 57 through the thin wall 59 and against the firing pin 44′ of the next cartridge 36′. The impact of the blow forces the conical portion 45′ of the firing pin 44′ against the cup 47′, thereby igniting the mercury fulminate 49′ therein and simultaneously igniting the fuse composition 51′ in the tube member 50′.

The fuse composition 51′ now burns at a rate depending upon the ingredients from which it is made. This rate may be so chosen that the ignition of the explosive in the main powder chamber 39′ will not take place until after a predetermined period of time has elapsed, corresponding to the interval which it is desired to produce between the firing of two successive cartridges. The gases produced by the burning of the composition 51′ flow into the auxiliary chamber 41′, through the labyrinth-like passage 53′ and through the apertures 54′ into the main chamber 39′. In traversing this path, the gases are cooled to a considerable extent by expansion, so that when they enter

the main chamber 39′ they are not hot enough to ignite the explosive 35′ contained therein.

The combustion of the last remnants of the fuse composition 51′ will ignite the explosive 35′ in the main chamber 39′, the gases from which will force the pin 58′ through the wall 59′ to the firing pin 44″ of the next cartridge 36″ which will then be fired in an analogous manner.

If desired, the cartridge 36 may be ignited mechanically by apparatus of the type shown in Fig. 3. In this figure, the cartridge 36 is identical with the cartridge 36′ of Fig. 2, and corresponding parts have been designated by unprimed reference numerals. Referring to Fig. 3, the cartridge 36 is shown disposed in one of the powder chambers 67 in a well casing perforating unit 68 of the type disclosed in the above mentioned copending application. The well casing perforating unit 68 is provided with three powder chambers like the powder chamber 67, which extend longitudinally therethrough and the axes of which form the apices of an equilateral triangle. Accordingly, in actual operation, there will be three cartridges 36 and three firing means therefor. For the sake of simplicity, however, only one firing means will be described hereinafter.

The well casing perforator unit 68 is threadedly secured to a connector element 69 provided with a longitudinal bore 70 within which is disposed a firing pin 71, the lower end of which rests against the firing pin 44 of the cartridge 36. Secured to the connector unit 69 is an elongated sleeve 72 through which the supporting cable 73 passes, the latter being secured to the connector element 69 in any suitable manner.

Slidably mounted on the sleeve 72 is an anvil 74 which is normally maintained out of engagement with the firing pin 71 by means of a compression spring 75. Within the anvil 74 is formed a recess 76 having a pivotally mounted pawl 77 therein which is urged in the direction of the sleeve 72 by means of a compression spring 78. The pawl 77 is adapted to cooperate with three spiral grooves 79, 80 and 81 formed in the sleeve 72 to reset the anvil 74 after it has been actuated, in preparation for the firing of another cartridge. It will be noted that the upper end of each groove overlies the lower end of the next adjacent groove.

In operation, let it be assumed that the anvil 74 is in the position shown in Fig. 3. If now it is desired to fire the cartridge 36, a split cylindrical weight 82 is placed around the cable 73 and is allowed to drop into the bore hole. The impact produced when the weight 82 strikes the anvil 74 moves the latter downwardly against the compression spring 75, and drives the firing pin 71 sharply against the firing pin 44 in cartridge 36. This ignites the cartridge 36 as described above in connection with Fig. 2.

As the anvil 74 moves downwardly, the pawl 77 is forced out of the upper end of the groove 79, and when the anvil 74 has reached the bottom of its stroke, the pawl 77 will enter the lower end of the spiral groove 80. When the energy of the blow produced by the weight 82 has been entirely dissipated, the restoring force of the compression spring 75 begins to move the anvil 74 upwardly to its normal position. During the return trip the pawl rides in the groove 80, and thus rotates the anvil 74 through an angle of approximately 120°, so that it is in position to fire the cartridge 36 in another series in the well casing perforator. The initiation of ignition in the second of cartridges is accomplished by dropping a second weight 83 down the cable 73, the operation of the apparatus being the same as described above.

The several representative embodiments described above are intended merely to be illustrative and not restrictive of the invention, and they are susceptible of numerous changes in form and detail within the scope of the appended claims.

MARCEL SCHLUMBERGER.

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BY A. P. C.

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CARTRIDGES

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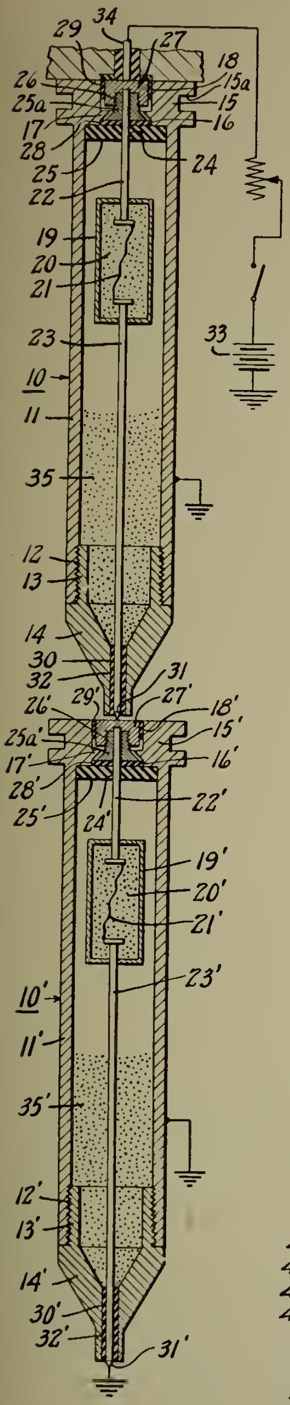

Fig. 1

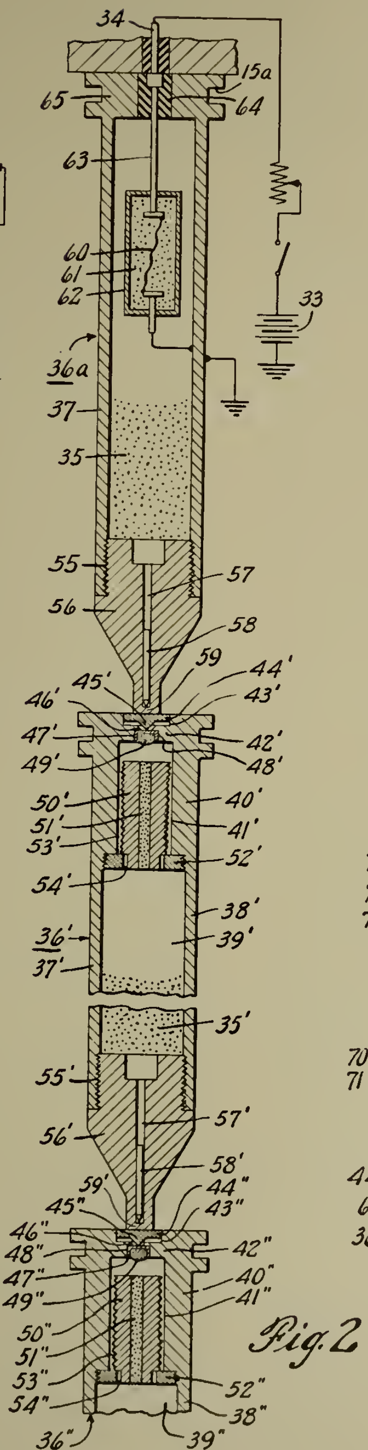

Fig. 2

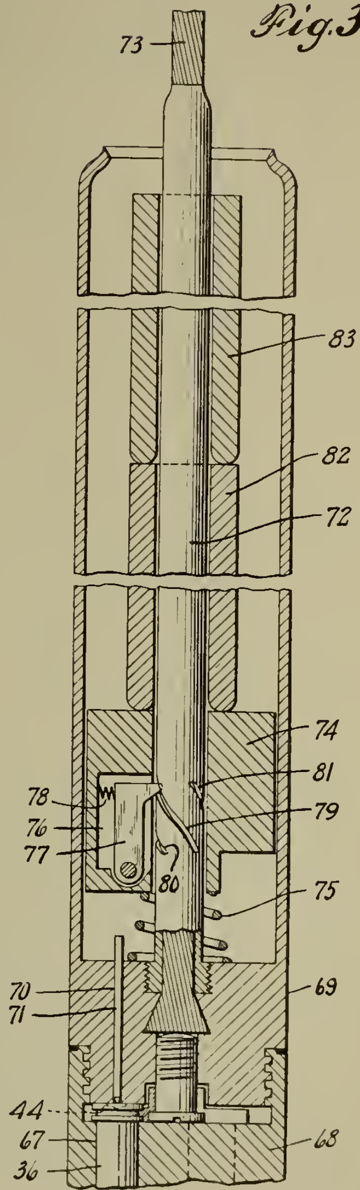

Fig. 3

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GUN FIRING APPARATUS

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Application filed July 23, 1941

The present invention relates to apparatus for controlling the firing of a plurality of explosive charges in a body such as a well casing perforator, for example, which is adapted to be located in a relatively inaccessible place.

In copending application Serial No. 315,157, filed January 23, 1940, for Gun perforator, of which this application is a division, there is disclosed well casing perforating apparatus having a plurality of guns, the axes of which lie in different horizontal planes and are angularly spaced about the longitudinal axis of the apparatus. The guns are adapted to be fired by a plurality of ignition circuits extending along the perforator, which are grounded to the perforator body at one end, and which are connected at the other end to corresponding conductors in the cable supporting the apparatus in the bore hole. The igniting circuits are adapted to be energized by a source of electrical energy located at the surface of the earth, one terminal of which is grounded to earth and the other terminal of which is connected through conventional switching means to the conductors in the cable.

It is an object of the present invention to provide new and improved switching means for connecting each of the ignition circuits in a gun perforator of the above character selectively to a single conductor in the supporting cable, whereby a mono-conductor cable may be used for carrying out perforating operations in a bore hole.

Another object of the invention is to provide new and improved switching means of the above character which is adapted to be actuated when a gun in the perforator is fired.

A further object of the invention is to provide new and improved switching means of the above character which is adapted to be actuated by the shock produced when one of the guns of the perforator is fired.

Additional objects of the invention will become apparent from the following detailed description of several embodiments taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic diagram illustrating switching means constructed according to the present invention in a gun perforator circuit;

Fig. 2 is a cross sectional view taken along line **2—2** of Fig. 1;

Fig. 3 is a schematic diagram of the igniting circuits for the gun perforator shown in Fig. 1; and

Figs. 4, 5 and 6 are views in longitudinal section of modified forms of switching means constructed according to the invention.

In Figs. 1 and 2, the switching means of this invention is shown as embodied in a gun perforator of the type disclosed in the above mentioned copending application. The gun perforator **10** includes a plurality of igniting circuits **11***a*, **11***b* and **11***c* which are grounded to the body of the perforator **10** at the points **12***a*, **12***b* and **12***c* (Fig. 3). The ignition circuit **11***a* includes a plurality of igniting filaments **13***a*, **13***a'* and **13***a''* for firing the corresponding guns (not shown) in the perforator **10**.

The igniting filaments **13***a*, **13***a'* and **13***a''* require different current values to bring them to red heat and means (not shown) is provided for grounding the free end of the next filament when one filament has been destroyed by the firing of the gun corresponding thereto, as disclosed in the above mentioned copending application, so that the guns in the perforator **10** may be fired successively by controlling the value of the current flowing through the igniting circuit **11***a*.

In similar fashion, the igniting circuit **11***b* includes a plurality of igniting filaments **13***b*, **13***b'* and **13***b''*, and the igniting circuit **11***c* includes a plurality of igniting filaments **13***c*, **13***c'* and **13***c''* which may be energized successively by controlling the values of the currents flowing through the circuits **11***b* and **11***c*, respectively.

At the surface of the earth is disposed a source of electrical energy **14**, one terminal of which is grounded to earth at the point **15** and the other terminal of which is connected through a conventional switch **16** and variable resistance **17** to a conductor **18** in the cable (not shown) on which the perforator **10** is supported in the bore hole. By means of the switching means **20** of this invention, the connections between the conductor **18** in the cable and the igniting circuits **11***a*, **11***b* and **11***c* are changed each time a gun is fired in the perforator **10**.

The switching means **20** comprises a connector element **21** formed with a shouldered portion **22** on which a metallic sleeve **23** is adapted to be rotatably mounted. Within the lower portion of the sleeve **23** is disposed an insulating sleeve **24** in which is embedded a conducting ring **25**. The conducting ring **25** is electrically connected through a conductor **26** to a conducting sector **27** which is also embedded in the insulating material **24**.

The conducting ring **25** is maintained in engagement with a contact rod **28** which is electri-

cally connected to an axial conducting rod 29 connected to its upper extremity to the conductor 18. The conducting rod 28 is insulated from the body of the perforator 10 by an insulating sleeve 30 and the axial conducting rod 29 is insulated in a similar manner by an analogous insulating sleeve 31.

Each of the igniting circuits is electrically connected to a contact member which is adapted to be moved into engagement with the conducting sector 27 embedded in the insulating material 24. Thus the igniting circuit 11*a* is connected to an insulated conducting rod 32*a* which has secured thereto a radially extending contact rod 33*a* which is disposed within an insulating sleeve 34*a* and which is adapted to engage the contact sector 27 as the sleeve 23 is rotated with respect to the connector element 21. In similar fashion, the igniting circuits 11*b* and 11*c* are connected through insulated conductors 32*b* and 32*c*, respectively, to radially extending contact rods 33*b* and 33*c*, respectively, which are also adapted to engage the contact sector 27 when the sleeve 23 is rotated (Fig. 2).

The connector element 21 is provided with a portion 35 of reduced diameter on which is disposed a coil spring 36, one end of which is secured to the connector element 21 at the point 37 and the other end of which is secured to a link 38 which is connected to the rotatable sleeve 23 at the point 39. The rotatable sleeve 23 is provided with a plurality of longitudinally extending teeth 40 which are adapted to be received in corresponding recesses 41 formed in a sleeve 42 which is carried on the connector element 21 so as to be slidable axially thereupon without rotation.

The sleeve 42 is normally urged downwardly by means of a coil spring 43, thereby engaging the teeth 40 on the sleeve 23 in the recesses 41 provided in the sleeve 42 and locking the sleeve 23 in position. Mounted on the sleeve 42 is a ring 44 made of flexible material, such as rubber, for example, and which is of substantially the same diameter as the bore hole casing into which the perforator 10 is to be lowered.

Before any of the igniting circuits may be energized, the position of the sleeve 23 with respect to the connector element 21 must be such that one of the contact rods 33*a*, 33*b* or 33*c* is in engagement with the sector 27. If, for example, the conducting sector 27 is in engagement with the contact rod 33*a*, a circuit is completed from the ground point 15 at the surface of the earth through the source of electrical energy 14, the switch 16, the variable resistance 17, the conductor 18, the conducting rod 29, the contact rod 28 engaging contact ring 25, the conductor 26, the conducting segment 27 engaging contact rod 33*a*, the contact rod 32*a* and the igniting circuit 11*a* to the ground point 12*a* on the perforator 10, the circuit being completed through the liquid in the bore hole and the intervening earth formations.

In order to ignite the lowermost filament 13*a''*, the switch 16 is closed and the variable resistor 17 is adjusted to give the required current value to accomplish this. As indicated above, the electrical characteristics of the igniting filaments 13*a* and 13*a'* are such that they will not ignite at this value of current.

The igniting of the filament 13*a''* fires the gun corresponding thereto, and the powder gases issuing from the corresponding gun barrel exert an upward thrust on the ring 44, thereby causing the teeth 40 to become disengaged from the recesses 41 and permitting the sleeve 23 to rotate with respect to the connector element 21. As soon as the energy in the gases has been dissipated, the spring 43 returns the sleeve 42 to its normal position, engaging the teeth 40 in the recesses 41 and again holding the sleeve 23 in fixed position.

The tensions in the springs 36 and 43 are so adjusted as to permit the sleeve 23 to rotate through a sufficient angle after it has been released to move the sector 27 out of engagement with the rod 33*a* and into engagement with the rod 33*b* in the igniting circuit 11*b*. The lowermost filament 13*b''* may then be ignited as indicated above in connection with the igniting filament 13*a''* and by continuing the operations in this fashion the guns in the perforator may be fired successively.

In the modification shown in Fig. 4, the conducting rod 29, which is in electrical connection with the conductor 18, terminates in an enlarged portion 45, the lower surface of which is curved at 46 and is in engagement with a spherical conducting ball 47. The conducting ball 47 rests upon a cup-shaped member 48 provided with a tubular shaft 49 which is movable axially in a bushing 50 secured within a tubular member 51 fixed to the connector element 21, and insulated from the member 51 by an insulating sleeve 52.

The tubular element 51 is provided with an outwardly extending flange 53 at the lower extremity thereof which is adapted to seat a compression spring 54, the upper end of which is seated in an annular recess 55 formed in the lower face of the cup-shaped member 48, thereby maintaining the spherical ball 47 in good electrical contact with the enlarged portion 45 of the conducting rod 29.

At the lower end of the tubular portion 49 on the cup-shaped member 48 is fitted a contact plate 56 which is continuously engaged by the actuator 57 of a conventional type commutating switch 58. The actuator 57 is made of conductive material and it serves to complete the circuit from the conducting plate 56 to one element of the switch 58. The switch 58 is adapted to connect the conducting rod 29 selectively to the conductors 32*a*, 32*b* and 32*c* in the igniting circuits 11*a*, 11*b* and 11*c*, respectively.

In operation, the shock produced when one of the guns in the perforator 10 is fired moves the spherical ball 47 transversely within the perforator 10, thereby moving the cup-shaped member 48 axially against the force of the compression spring 54. This action depresses the actuator 57 of the switch 58, connecting the conducting rod 29 to the next igniting circuit which is to be energized.

The modification illustrated in Fig. 5 is similar to that shown in Fig. 4, except that the spherical ball 47 is replaced by a cylindrical conducting mass 59 which is elastically suspended in the connector element 21 by suitable supports 60 made of resilient material, such as rubber, for example. In this modification, the switch 58 is provided with an extended actuator 61 which projects into a conical recess 62 formed in the lower face of the cylindrical mass 59. As in the previous case, when one of the guns in the perforator 10 is fired, the latter is moved laterally with respect to the mass 59 and the inclined surface of the conical recess 62 therein depresses the switch actuator 61, thereby disconnecting the conducting rod 29 from one igniting circuit and connecting it to a different igniting circuit.

The modification shown in Fig. 6 is similar to that shown in Fig. 1. In this embodiment, however, the sleeve **23** is adapted to be rotated with respect to the connector element **21** by means of a coil spring **63** which is secured on the connector element **21** at the point **64**. The interior wall of the sleeve **23** is provided with a plurality of spaced recesses **65**, within which a transversely extending rod **66** is adapted to be received for the purpose of holding the sleeve **23** in fixed position. The rod **66** is continuously urged into engagement with the recess **65** by means of a compression spring **67**, one end of which is seated within an annular recess **68** formed in the wall of the connector element **21** and the other end of which is seated against a disc **69** secured to the rod **66**.

A large mass **70** is suspended within the connector element **21** on a flexible cable **71** and it is connected at its lower end by means of a flexible cable **72** to one arm **73** of a bell crank mechanism **74** which is pivoted at **75**. The other arm **76** of the bell crank mechanism **74** is provided with a slot **77** within which a pin **78** on the rod **66** is adapted to be received. The conducting rod **29** which supplies current to the igniting circuits is connected by means of a conductor **79** to an insulated conducting rod **80** which is maintained in engagement with the conducting ring **25** in the sleeve **24**.

When one of the guns in the gun perforator **10** is fired, the shock imparted to the perforator assembly causes the latter to move laterally with respect to the mass **70**, turning the bell crank mechanism **74** about the pivot point **75** and disengaging the rod **66** from the recess **65**. This permits the sleeve **23** to rotate under the influence of the spring **63** through a sufficient angle to bring the conducting sector **27** into engagement with the conducting rod **32*b*** corresponding to the next igniting circuit **11*b***. By this time the mass **70** has returned to its normal position and the rod **66** is again moved into engagement with one of the recesses **65** by means of the compression spring **67**.

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GUN FIRING APPARATUS

Original Filed Jan. 23, 1940

Serial No. 403,649

2 Sheets-Sheet 1

Fig. 1

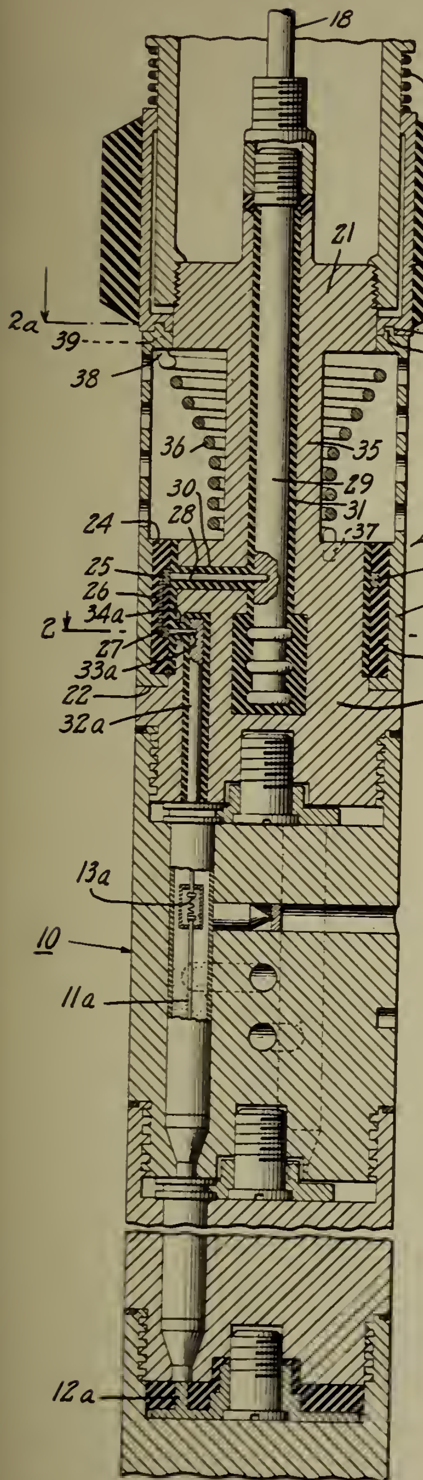


Fig. 2

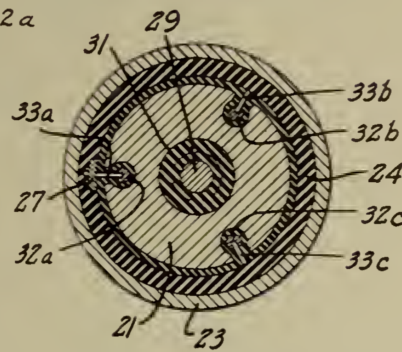
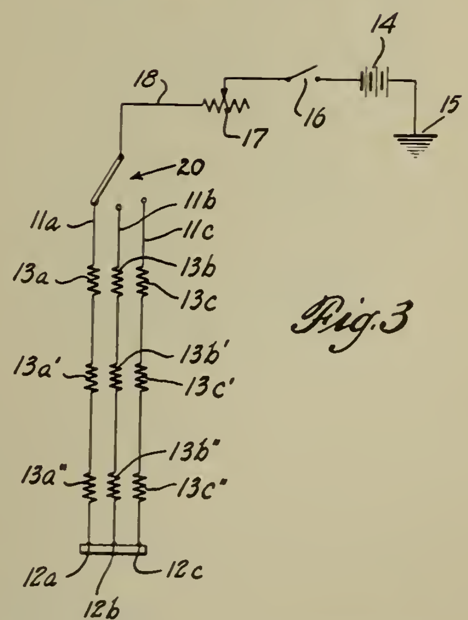


Fig. 3



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2 Sheets-Sheet 2

Fig.4

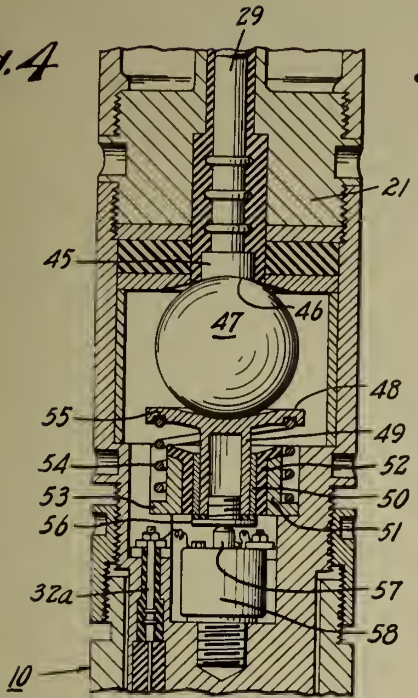


Fig.2a

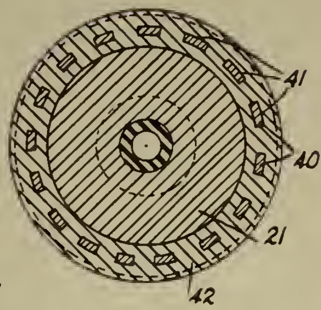
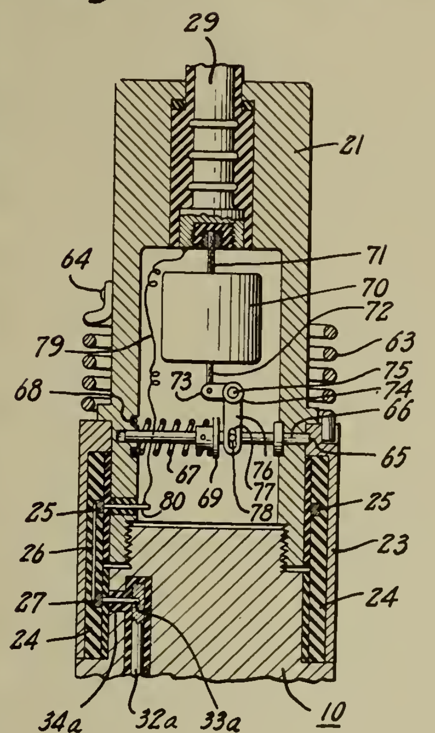


Fig.6



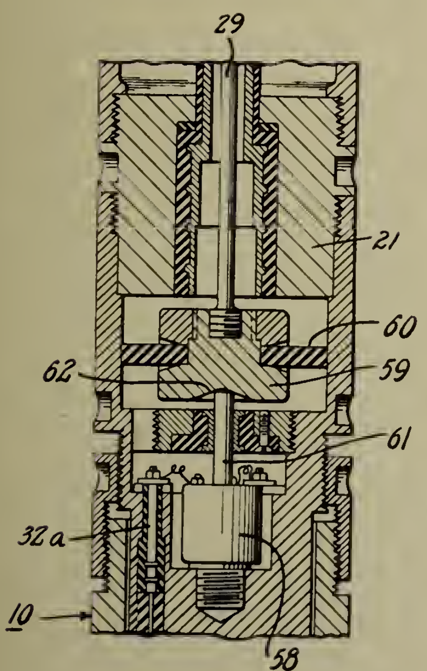


Fig.5

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ALIEN PROPERTY CUSTODIAN

WELL CASING PERFORATOR

Marcel Schlumberger, St. Gaudens, Haute Garonne, France; vested in the Alien Property Custodian

Application filed July 23, 1941

This invention relates to firing devices and more particularly to new and improved apparatus for perforating well casings and the like.

Copending application Serial No. 315,157, filed January 23, 1940, for Gun perforator, of which this application is a division, is addressed to perforating apparatus comprising an assembly of similar units each of which is provided with a plurality of gun bores and cartridge chambers therein. Each unit includes igniting means for each gun therein and the apparatus is so designed that when the units are assembled, at least one continuous ignition path extends through the perforator.

This application is directed to similar apparatus in which the units are so designed that when assembled, the axes of the guns therein lie along a helix about the periphery of the perforator.

It is an object of the invention, accordingly, to provide new and improved well casing perforating apparatus comprising a plurality of assembled similar units in which the axes of the guns in the respective units lie along a helix about the perforator assembly.

Another object of the invention is to provide new and improved means for firing the guns in a well casing perforator of the above character in successive order.

A further object of the invention is to provide new and improved well casing apparatus of the above character in which a given interval of time elapses between the firing of each adjacent gun.

Another object of the invention is to provide means for indicating at the surface of the earth that a gun in the well casing perforator has been fired.

Other features of the invention will become apparent from the following detailed description of several preferred embodiments taken in connection with the accompanying drawings, in which:

Fig. 1 is a view in longitudinal section, taken along line 1—1 of Fig. 3, and looking in the direction of the arrows, through a well casing perforator constructed according to the present invention;

Fig. 2 is a view in longitudinal section, taken along line 2—2 of Fig. 3, looking in the direction of the arrows and illustrating two of the perforating units of the well casing perforator:

Fig. 3 is a view in section taken along line 3—3 of Fig. 1, looking in the direction of the arrows;

Fig. 4 is a view in vertical section of a modified form of the invention;

Fig. 5 is a cross-sectional view taken along line 5—5 of Fig. 4, looking in the direction of the arrows;

Fig. 6 is a cross-sectional view taken along line 6—6 of Fig. 4;

Fig. 7 is a view in plan of a detail of the apparatus shown in Fig. 4;

Fig. 8 is a view in section of the detail shown in Fig. 7 taken along line 8—8 thereof and looking in the direction of the arrows;

Fig. 9 is a view in longitudinal section through a further modification of the invention; and

Fig. 10 is a cross-sectional view taken along line 10—10 of Fig. 9, looking in the direction of the arrows.

Figs. 1, 2 and 3 illustrate one form of the invention in which each of the perforator units comprises three longitudinally extending cartridge chambers, the axes of which form the apices of an equilateral triangle about the axis of the unit, each one of which is provided with a laterally extending gun barrel passing through the longitudinal axis of the unit. The units are so designed that when assembled to form a well casing perforator, the axes of the guns lie upon a helix about the periphery, and the guns are adapted to be fired by electrical igniting circuits extending through each unit in the perforator assembly.

Referring to Figs. 2 and 3, one of the perforator units **10** is shown, in which are provided three cartridge chambers **11***a*, **11***b* and **11***c*, the axes of which are located parallel to the axis of the unit **10**, forming the respective edges of an equilateral prism coaxial thereto. The cartridge chambers **11***a*, **11***b* and **11***c* are provided at their lower extremities with longitudinally extending conduits **12***a*, **12***b* and **12***c*, which communicate with a plurality of laterally extending gun barrels **13***a*, **13***b* and **13***c*, the axes of which are disposed at an angle of 120° with respect to each other. In order that the gun barrels **13***a*, **13***b* and **13***c* may lie in different transverse planes through the perforator unit **10**, the conduits **12***a*, **12***b* and **12***c*, respectively, are made of different lengths.

Considering now Fig. 1, a cartridge **14** is shown in position in the cartridge chamber **11***b*, for example, and it is provided with a thin walled forward portion **15** forming a powder chamber **16** and a thicker walled rear portion **17** forming a passage **18**. The front end of the cartridge **14** is closed by a suitable closure member **19**. Within the passage **18** is disposed a hollow tubular conducting member **20** which is provided with a metal plate **21** at the upper extremity thereof, the

outer surface of both the plate 21 and the tubular member 20 being covered with suitable insulating material 22.

Disposed within the tubular member 20 and concentric therewith is a conducting rod 23 which extends for a short distance beyond the tubular member 20 into the chamber 16 in the cartridge 14. The conducting rod 23 is provided at its upper extremity with a metal plate 24, the surface of both being encased in suitable insulating material 25. A wire filament 26 for igniting the powder charge within the chamber 16 is connected at one end to the tubular member 20 and at its other end to the conducting rod 23 and the energizing circuit therefor is traced through the conducting plate 24, the conducting rod 23, the wire filament 26, the tubular conducting member 20 and the plate 21.

Within the perforator unit 10 are provided three longitudinally extending bores 27, the axes of which are disposed substantially at the apices of an equilateral triangle, and each of which is adapted to accommodate a conducting rod 28. The rods 28 are provided with pointed ends which project slightly beyond the upper and lower faces of the perforator unit 10 and they are insulated therefrom by sleeves of suitable insulating material 29.

As shown in greater detail in Fig. 3, each of the conducting plates 24 is provided with a laterally extending portion 30 and each conducting plate 21 is provided with a similar projecting portion 31. The cartridge 14 is so assembled that the projection 30 on the plate 24 is disposed substantially 180° away from the projection 31 on the plate 21 and it is inserted into the cartridge chamber 11b in such fashion that the projection 31 on the plate 21 is disposed adjacent the pointed end of one of the rods 28.

The perforator units are so designed that when the unit 10, for example, is threadedly secured to the unit 10′, the pointed end of the conducting rod 28 of the perforator unit 10 pierces the insulating layer 25′ covering the projection 30′ of the conducting plate 24′ while the pointed end of a similar conducting rod in the perforator unit 10′ makes an analogous connection with the conducting plate 21′.

It will be apparent, therefore, that, in operation, current will flow through the conducting plate 24, the conducting rod 23, the filament 26, the tubular conducting member 20 and the conducting rod 28 in the perforator unit 10 to the contact plate 24′ of the next lower perforator unit 10′. In this fashion current is supplied to each series of cartridges 14 in the assembled perforator.

It will be noted further that in this embodiment of the invention the current path is not along a line parallel to the axis of the assembled perforator. On the contrary, the current flows along a line parallel to the axis of the perforator unit 10, then along a line located at an angle of approximately 115° away and parallel to the axis of the next succeeding perforator unit 10′ and so on through the respective units of the assembled apparatus.

In order that the cartridges 14 may be readily inserted within the respective cartridge chambers in the perforator unit 10, the internally threaded skirt portion 32 thereof may be suitably notched as at 33, for example.

The well casing perforator is made up by screwing together a plurality of units 10, 10′ etc., the number depending upon the number of shots which are to be fired into the casing. The topmost unit 10 is then screwed to a connector unit 34 by means of which the respective igniting circuits in the perforator apparatus may be electrically connected to corresponding conductors in the supporting cable (not shown).

The connector unit 34 is of a special type which is adapted to break an igniting circuit each time that a gun is fired, thereby indicating to the operator at the surface of the earth that the firing operation has been successful. Circuit breaking means of this character is used in each of the three igniting circuits in the well casing perforator. For the sake of simplicity, however, only one igniting circuit and the circuit breaking means therefor are shown in Fig. 1.

Referring again to Fig. 1, the conductor 35 in the supporting cable is secured by means of a conventional tap screw 36 within a recess 37 formed in a conducting block 38. The block 38 is insulated from the connector unit 34 by means of suitable insulating material 39. The tap screw 36 is electrically connected through a wire 40 to one contact element 41 of a conventional type mercury switch 42 which is vertically disposed within a sleeve 43 made of flexible material such as rubber, for example, and which contains just enough mercury to remain in contact with the contact element 41 when the connector unit 34 is at rest.

The other contact element 44 of the switch 42 is connected by means of a conductor 45 to a conducting block 46. The block 46 is connected by means of the conductors 47 and 48 to an insulated conducting rod 49 which is adapted to engage the projection 30 on the conducting plate 24 in the first perforator unit 10.

When the assembled perforator is at rest, the contact element 41 dips into the mercury in the switch 42 so that electric current flows normally therethrough to the firing circuit. However, when a shot is fired, the entire perforator assembly sustains a violent shock which displaces the mercury and temporarily breaks the electrical firing circuit. The break in the circuit may be readily indicated in any suitable manner, as, for example, by listening to a telephone receiver connected in the circuit at the surface of the earth. In this fashion, it is possible to check the firing of the shots by noting the break produced in the electrical circuit by the shock sustained when a gun is fired.

In operation, the filaments in the cartridges in each igniting circuit are ignited successively by adjusting the value of the current flowing therethrough. To this end, the igniting filaments of different electrical characteristics are used, the lowermost one in the perforator being designed to be ignited first. When any filament has been ignited, for example, the filament 26, the force of the explosion destroys the insulating material 22 and 25, thereby grounding the rod 23 to the perforator body, so that the igniting circuit remains closed. The flow of conducting bore hole liquid into the powder chamber 11b through the gun bore 13b after the projectile therein has been fired also tends to ground the conducting rod 23, in which case the igniting circuit is completed directly through the conducting bore hole liquid.

In the embodiment shown in Fig. 4, a disc 50 is secured to the bottom of the perforator unit 10 by means of a conventional tap screw 51. The disc 50 is provided with internally threaded recesses 52 therein within which are secured the cartridges for firing the guns. Each threaded

recess **52** communicates through a narrow passage **54** with a larger sector-shaped recess **55** formed in the upper face of the disc **50**, within which is disposed a metallic plate **56** of approximately the same shape, which is enclosed in suitable insulating material **57**.

As shown in greater detail in Figs. 7 and 8, a small portion of the insulation is removed from the upper face of the plate **56**, forming a slot **58** therein and part of the insulation is removed from the lower face of the plate **56** to form a small hole **59** therein which is adapted to register with the narrow passage **54** in the disc **50**. The connector element **34** is provided with a similar disc **50***a* and corresponding parts have been designated with corresponding reference numerals with the subscript *a*.

The cartridge **53** is provided with an upper closure member **60** having a passage **61** therein, within which is disposed an insulating sleeve **62** having a contact rod **63** therein. The cartridge **53** also has a lower closure member **64** made of suitable insulating material, in which is inserted a conducting rod **65**. The conducting rod **65** is enclosed in a sleeve **66** of insulating material within a passage **67** in the perforator unit **10** and it is provided with a pointed end which is adapted to project through one of the slots **58** into engagement with one of the plates **56** in the disc **50**. A wire filament **68** is connected between the contact rod **63** and the contact rod **65**, which filament serves to ignite the powder in the cartridge **53**.

When the perforator units **10**, **10'**, etc., are assembled as shown in Fig. 4, it will be noted that the contact rods **65** on the cartridges **53** in the perforator **10** extend through the upper slots **58** in the insulation **57** into engagement with the contact plates **56**. Also, the contact rods **63** of the cartridges **53** in the perforator unit **10** project through the passages **54***a* in the disc **50***a* into engagement with the contact plates **56***a* as shown in Fig. 5. Similar connections obtain between the perforator units **10** and **10'** as illustrated in Fig. 6 so that three continuous firing circuits are produced in the assembled perforator.

It will be apparent that in this modification the successive cartridges **53** through which the firing current passes are located in different radial planes, the angle between any two successive radial planes being approximately equal to the angle subtended by the contact plate **56**.

Figs. 9 and 10 illustrate another embodiment of the invention in which ignition is transmitted automatically from one cartridge to another cartridge located along a different generatrix of the perforator. In this embodiment, each cartridge **69** is provided with a lower closure portion **70** having a very narrow bore **71** formed therein. The bore **71** is adapted to register with a narrow inclined passage **72** formed in the perforator unit **10** which extends to the cartridge **69'** in the next perforator unit **10'** which is located on a different generatrix.

In this embodiment, the guns in the uppermost perforator unit **10** are preferably fired electrically and to this end the cartridge **69** is provided with an igniting filament **74** grounded at one end to the metallic cartridge case **75** and connected by means of an insulated conductor **76** to the contact rod **49** which is connected to the conductor **35** in the supporting cable.

When the cartridge **69** is fired by passing electrical current through the igniting filament **74**, the powder gases pass through the narrow bore **71** in the lower closure member **70** of the cartridge **69** to the inclined passage **72**, where they are allowed to expand. The expanded gases then pass to the upper end of the cartridge **69'** in the next perforator unit **10'** where they flow through a restricted aperture **77'** and through a passage **78'** to the charge of powder contained within the cartridge **69'**, which is ignited thereby.

The passage through the restricted bore **71** and the subsequent expansion in the inclined passage **72'** produce a delay in the transmission of ignition so that a certain interval of time elapses between the firing of the successive cartridges.

From the foregoing, it will be apparent that the invention provides new and improved well casing perforating apparatus which is characterized by simplicity and increased safety of operation. Moreover, the applicant's novel circuit breaking means provides an indication at the surface of the earth each time that a gun is fired, thus enabling the operator to ascertain if the apparatus is functioning properly.

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WELL CASING PERFORATOR
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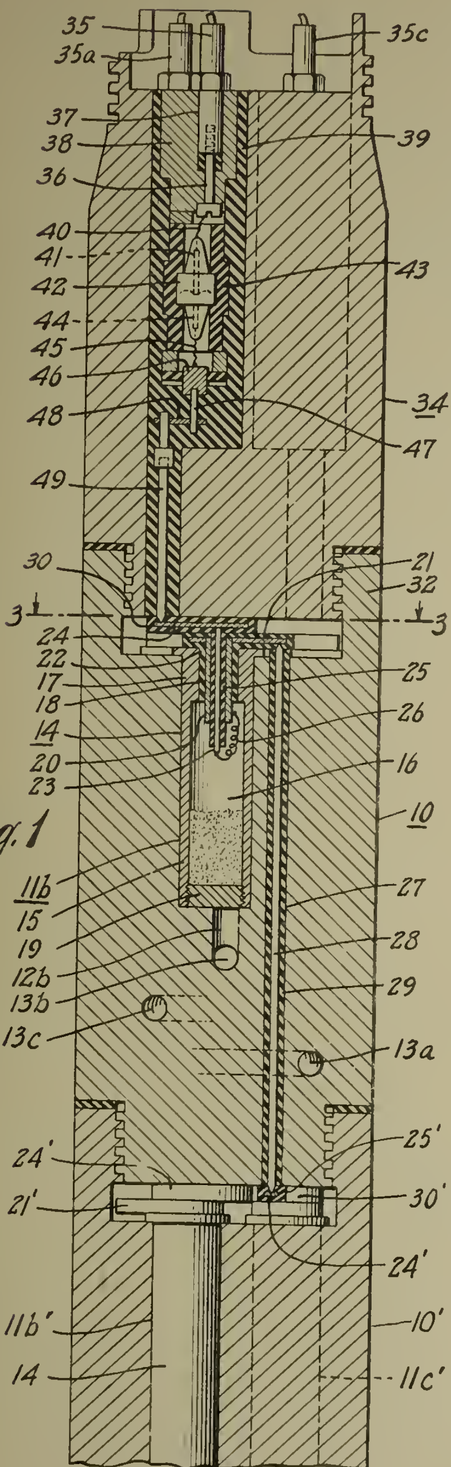

Fig. 1

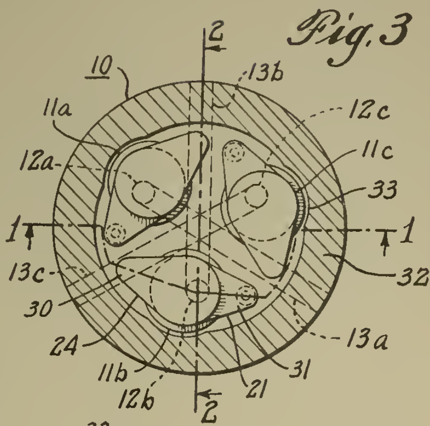

Fig. 3

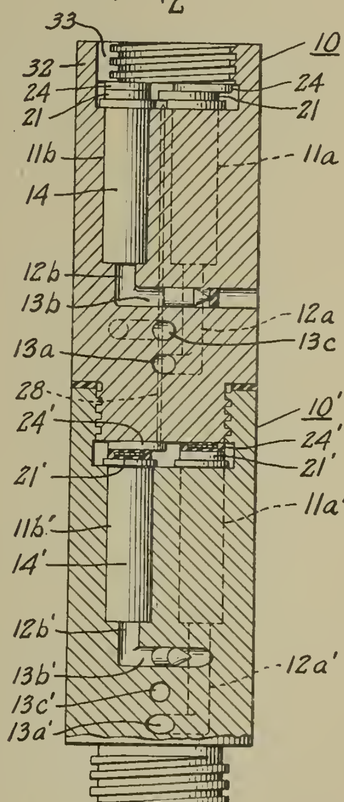

Fig. 2

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2 Sheets–Sheet 2

Fig. 4

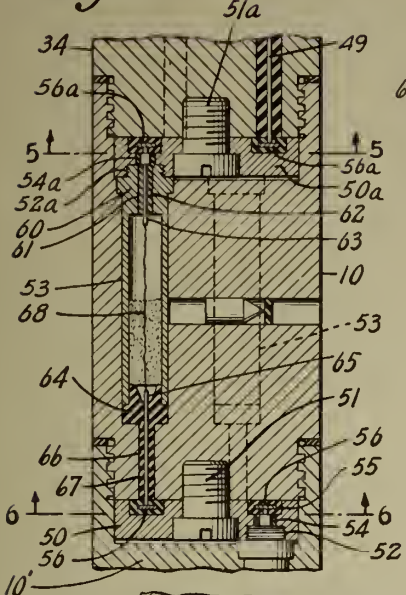


Fig. 5

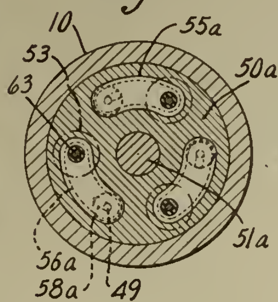
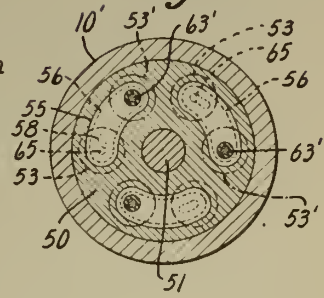


Fig. 6



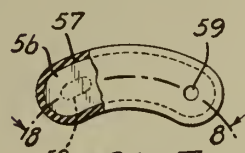


Fig. 7

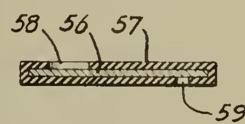


Fig. 8

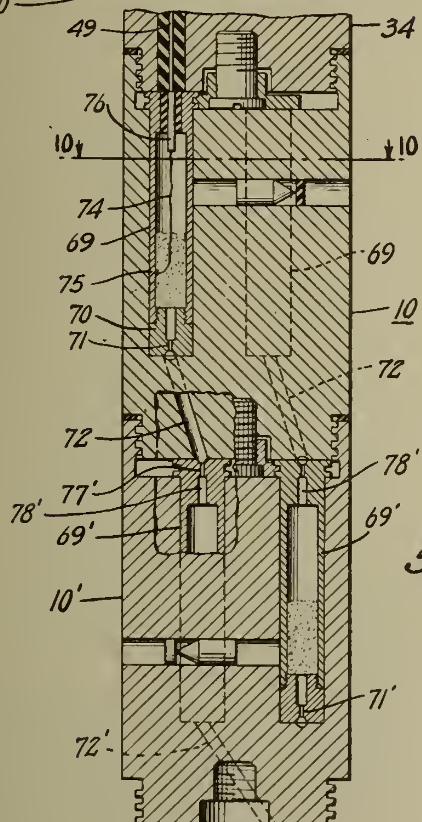


Fig. 9

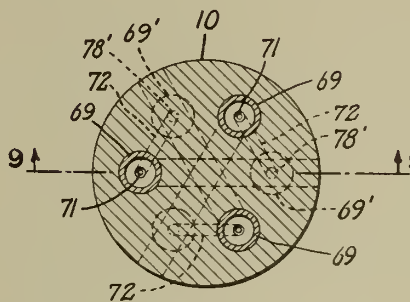


Fig. 10

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ALIEN PROPERTY CUSTODIAN

WELL CONDITIONING APPARATUS

Marcel Schlumberger, St. Gaudens, Haute Garonne, France; vested in the Alien Property Custodian

Application filed August 1, 1941

The present invention relates to new and improved methods and apparatus for sealing off the space between the wall of a bore hole and its casing at any desired depth or depths therein.

In the exploitation of oil wells drilled into the earth, good engineering practice requires that the space between the wall of the bore hole and the casing which is usually inserted therein be sealed off at a predetermined location or locations in order to prevent the flow of fluid or gas therealong from one subterranean bed to another. This is also essential in order to permit the oil bearing layers to be exploited separately.

Heretofore, it has been the practice to pump a suitable cement slurry through the casing to the bottom of the bore hole and up into the space between the casing and the wall of the bore hole. This method is adequate for sealing off the casing at points near the bottom of the bore hole, but it has not been found satisfactory for sealing off the casing at points at relatively great distances from the bottom of the bore hole. In the latter cases, the method is costly because of the large quantities of cement required and the seals produced are often ineffective because the cement is frequently not evenly distributed about the casing.

It is an object of the present invention, accordingly, to provide new and improved methods and apparatus for sealing off the space between the wall of the bore hole and its casing which are free from the disadvantages of the prior art noted above, and which are more simple, flexible and economical in operation.

Another object of the invention is to provide new and improved apparatus of the above character which is adapted to perforate the casing, and also to inject sealing material into the space between the wall of the bore hole and the casing through the perforation or perforations formed therein.

Still another object of the invention is to provide new and improved apparatus of the above character in which the sealing material is directed to perforating and injecting means in the casing from a source located at the surface of the earth.

A further object of the invention is to provide new and improved apparatus of the above character wherein the sealing material is disposed in a container located in the casing with the perforating and injecting means and is adapted to be supplied therefrom to the injecting means.

Another object of the invention is to provide new and improved apparatus of htc above character wherein the means for injecting the sealing material forms a part of the perforating means and includes detachable means for plugging the perforation in the casing after the sealing material has been injected therethrough.

Still another object of the invention is to provide a new and improved method of the above character in which the sealing material employed is adapted to harden rapidly after having been injected into the space between the wall of the bore hole and the casing.

A further object of the invention is to provide a new and improved method of the above character wherein the sealing material at about the time of its injection into the space between the wall of the bore hole and the casing is mixed with an ingredient which causes it to harden rapidly.

Other objects and advantages of the invention will become apparent from the following detailed description of several preferred embodiments, taken in conjunction with the accompanying drawings in which:

Fig. 1 is a view in vertical section illustrating apparatus constructed according to the present invention for perforating the casing of a bore hole and for injecting sealing material into the space between the wall of the bore hole and the casing.

Fig. 2 is a cross-sectional view taken along line 2—2 of Fig. 1 and looking in the direction of the arrows, showing the perforating means in the normal inoperative position.

Fig. 3 illustrates the perforating means shown in Fig. 2 after the perforation of the casing has been completed.

Fig. 4 shows the perforating means of Fig. 2 in the retracted position after the perforating operation has been completed.

Figs. 5, 6, 7 and 7*a* illustrate a number of different forms of perforating punches constructed according to the present invention.

Figs. 8 and 8*a* are views in longitudinal section of a modified form of the apparatus shown in Fig. 1, which is adapted to be lowered into a bore hole on a conventional electrical cable.

Figs. 9 and 9*a* illustrate further modifications of the apparatus shown in Fig. 8.

Referring to Fig. 1, a bore hole **10** is shown having a casing **11** therein slightly smaller in diameter than the diameter of the bore hole **10**, forming an annular space **12** between the wall of the bore hole **10** and the casing **11**. For convenience it will be assumed that it is desired to form a seal in the space **12** in the vicinity of

the upper boundary of an oil bearing formation 13 traversed by the bore hole 10.

Within the casing 11 and in the vicinity of the formation 13 is disposed apparatus for perforating the casing and for introducing the sealing material into the space 12 between the wall of the bore hole 10 and the casing 11. This apparatus comprises a body 14 made of steel or other suitable material, having a cylindrical chamber 15 formed in the upper portion thereof within which is slidably mounted a piston 16 of relatively large area. The piston 16 is maintained normally near the top of the chamber 15 by means of a compression spring 17 which is seated in an annular recess 18 formed in the bottom of the chamber 15 and the upper end of which engages the lower face of the piston 16.

The lower portion of the piston 16 is formed as a coaxial cylindrical plunger 19 which is considerably smaller in diameter than the piston 16, and which is slidably mounted within a bore 20 communicating at its upper end with the cylinder 15. The bore 20 communicates through a passage 21 with a cylindrical chamber 22 which extends transversely of the body 14 and which terminates in an opening 22*a* formed in the wall of the body 14. The portion of the chamber 22 which is nearest the opening 22*a* is internally threaded at 23 to receive an externally threaded barrel 24 having a central bore 25 formed therein within which a cylindrical perforating and injecting element 26 is slidably fitted.

Located below the chamber 22 and communicating therewith through a passage 42*a* is a second chamber 22′ in which is slidably mounted a perforating and injecting element 26′. Corresponding parts in the lower element 26′ and associated apparatus are designated by primed reference characters. Usually there will be a plurality of perforating and injecting elements located about the periphery of the body 14. For the sake of simplicity, however, only two are shown in Fig. 1.

Referring now to Fig. 2, the injecting and perforating element 26′ is slightly smaller in diameter than the diameter of the chamber 22′ and it has a laterally extending rear portion 27′ which cooperates with the barrel portion 24′ to limit the extent of movement of the perforating and injecting means 26′. The rear portion 27′ of the injecting and perforating element 26′ is provided with a circumferential groove 28′ within which is disposed suitable packing material 29′ for providing a tight joint.

In one side of the perforating and injecting means 26′ is formed an aperture 30′ providing communication with the hollow interior 31′ thereof. At the forward end of the perforating and injecting means 26′ is provided a closure member 32′ within which are formed a plurality of longitudinal extending passages 33′ and 34′. Mounted on the closure member 32′ and secured thereto by means of a suitable screw 35′ is a punch 36′ within which are formed a plurality of longitudinal grooves 37′ and 38′ which are adapted to register with the passages 33′ and 34′, respectively, permitting sealing material to be injected from the interior 31′ of the perforating and injecting means 26′ through the passages 33′ and 34′ and the grooves 37′ and 38′ into the space 12 between the wall of the bore hole 10 and the casing 11, as described in greater detail hereinafter.

Formed in the piston 16 is a longitudinally extending passage 39 which communicates with a longitudinally extending aperture 40 formed in the side wall of the plunger 19. The dimensions of the aperture 40 are so chosen that it is entirely closed when the piston 16 is in its uppermost position, but when the piston 16 is in its lowermost position it communicates with an aperture 41*a* formed in the wall of the chamber 20. The aperture 41*a* communicates with a downwardly extending passage 41 formed in the body 14 which in turn communicates with an aperture 42 formed in the wall of the bore 25 in the barrel 24.

The passage 41 continues downwardly through the body 14 and through the barrel portion 24 to an aperture 42′ formed in the wall of the bore 25′ in the barrel 24′ located in the body 14 below the barrel 24.

In this embodiment of the invention, the apparatus is lowered into the casing 11 on a conventional string of drill pipe 43, at the lower end of which is formed a laterally extending flange 44 which is adapted to be rotatably received within a corresponding groove 45 formed in a head piece 46. The drill pipe 43 is provided with an aperture 47 which is adapted to register with a laterally extending passage 48 formed in the head piece 46 when the string of pipe 43 is rotated with respect to the head piece 46 for the purpose of placing the hollow interior of the drill pipe 43 in communication with the liquid within the casing 11.

At the surface of the earth, the string of drill pipe 43 is connected to a length of flexible tubing 49 to which fluid under pressure is supplied from suitable pumping means 50 located at the surface of the earth.

In operation, the body 14 is lowered on the string of drill pipe 43 until the perforating and injecting elements 26 and 26′ are located approximately at the depth of the upper boundary of the formation 13 where it is desired to form the seal. A liquid cement mixture is then pumped from the pumping means 50 through the flexible tubing 49 and through the string of drill pipe 43 into the chamber 15. At this time, of course, the aperture 47 in the drill pipe 43 will be out of registry with the passage 48 in the head piece 46.

The fluid pressure of the cement mixture within the chamber 15 forces the piston 16 downwardly against the pressure of the spring 17, moving the plunger 19 downwardly and applying pressure to a body of pressure transmitting fluid such as oil 20*a*, for example, contained within the bore 20 and the chambers 22 and 22′. The pressure of the oil 20*a* forces the perforating and injecting means 26 and 26′ outwardly and radially against the casing 11, as shown in Fig. 1.

The application of pressure by the pumps 50 is continued until the punches 36 and 36′ on the perforating and injecting elements 26 and 26′, respectively, are forced through the casing 11 as shown in Fig. 1. At this time it will be noted that the aperture 40 in the plunger 19 is in registry with the aperture 41*a* in the wall of the bore 20 while the aperture 42 is in communication with the hollow interior 31 of the perforating and injecting means 26 through the aperture 30 therein. Accordingly, the cement mixture above the piston 16 is forced through the passage 39, the aperture 40, the aperture 41*a*, the passage 41, the aperture 42 in the perforating and injecting means 26, the passages 33 and 34 therein and the grooves 37 and 38, respectively, in the punch 36 into the space 12 between the wall of the bore hole 10 and the casing 11. In similar fashion, cement is also injected through the per-

forating and injecting means 26′ into the space 12.

When a sufficient quantity of cement has been deposited in the space 12 to form a sealing ring therein, the operation of the pumping means 50 is stopped and the string of drill pipe 43 is rotated to bring the aperture 47 therein into registry with the passage 48 in the head piece 46. Fresh water is then pumped through the flexible tubing 49 for the purpose of cleaning out the interior of the string of drill pipe 43 and removing any excess cement therefrom.

The reduced pressure in the chamber 15 permits the coil spring 17 to restore the piston 16 to its uppermost position, thereby reducing the oil pressure in the bore 20. Under these conditions, the perforating and injecting means 26 and 26′ are withdrawn from the casing 11 and into their normal positions, as shown in Fig. 2.

As shown in greater detail in Fig. 2 the punch 36′ is provided with a conical forward portion 51′, an intermediate portion 52′ which is slightly smaller in diameter than the greatest diameter of the conical portion 51′ and a rear portion 53′ which diverges outwardly and abuts the forward end of the perforating and injecting element 26′. Experience has shown that a punch of this shape has a marked tendency to become jammed in the metal casing. As a result, a relatively large force is necessary to withdraw the punch after the casing has been perforated, from one to two tons being required for a perforating pressure of about fifteen tons.

The screw 35′ which secures the punch 36′ to the closure member 32′ is made of relatively small section and is designed to break under a tensile stress which is less than that required to withdraw the punch 36′ from the casing 11. Accordingly, when a force is applied to restore the perforating and injecting means 26′ to its normal position, the screw 35′ will break, leaving the punch 36′ jammed in the casing 11, as shown in Fig. 4, forming an effective closure for preventing fluid transfer between the interior of the casing 11 and the space 12 between the wall of the bore hole 10 and the casing 11.

After the screw 35′ has been broken, the perforating and injecting means 26′ will return to its normal retracted position within the chamber 22′, as shown in Fig. 4. Similarly, the perforating and injecting means 26 will be restored to its normal inoperative position. The body 14 may then be moved to another position in the bore hole or it may be withdrawn therefrom.

Instead of using a conventional cement mixture, the sealing material might comprise a product having the property of setting by hydration. Such materials may be kept out of contact with water by the novel perforating and injecting apparatus described above and would come into contact with water only after having been injected into the space 12.

It is also possible to use as sealing materials substances which are normally solid at the temperatures usually encountered in wells, but which flow freely at higher temperatures. Lead base alloys such as mixtures of lead and tin have been found satisfactory for this purpose. Such substances can be injected into the space 12 while in the molten state and form an effective seal upon solidification by cooling.

In Figs. 5 and 6 are illustrated a plurality of different punches which are not designed to form a closure for the perforation in the casing after the sealing material has been injected therethrough. In the embodiment shown in Fig. 5, the punch 52*a* is provided with a sharp conical point 53*a* and the sealing material is adapted to be supplied through an aperture 54 and a longitudinal passage 55 to a laterally extending passage 56 therein. By virtue of the laterally extending passage 56, a gyratory movement around the casing 11 is imparted to the sealing material, thus forestalling an uneven distribution of sealing material about the casing 11.

In Fig. 6, the punch 57 tapers inwardly from the front to the rear so that its front diameter is slightly greater than its rear diameter. A punch of this character produces a perforation in the casing 11 which is similar to that produced by a perforating bullet. The sealing material passes through passages 58 in the perforating and injecting element 26 and through the space between the punch 57 and the perforation in the casing 11 into the space 12 between the bore hole 10 and the casing 11.

The embodiment shown in Figs. 7 and 7*a* is adapted to form a closure for the perforation in the casing after the sealing material has been injected therethrough. In this embodiment, the injecting means 26 is provided with a forward closure member 60 in which is formed a centrally located aperture 61. In the front face of the perforating and injecting means 26 is formed a cylindrical recess 62 within which is tightly fitted a cylindrical member 63 provided with a central bore 64 within which is mounted the shank 65 of a punch 66.

The rear portion of the shank 65 is externally threaded at 67 to receive a threaded conical member 68 which is very weakly secured to a rod 69 on the end of which is formed a laterally extending disk 70 for limiting the longitudinal movement of the punch 66. The disk 70 is provided with one or more apertures 71 therein for permitting sealing material to pass from the hollow interior 31 of the perforating and injecting means 26 therethrough. The sealing material passes through the space between the aperture 61 and the rod 69 and through suitable apertures 72 and 73 formed in the cylindrical member 63 and the spaces 74 and 75 between the front face of the cylindrical member 63 and the rear face of the punch 66.

When the injection of the sealing material has been accomplished and force is applied to the perforating and injecting element 26 to withdraw it from the casing 11, the cylindrical member 63 becomes disengaged from the recess 62 and the weak connection between the conical member 68 and the rod 69 is broken, leaving the cylindrical member 63 tightly jammed within the perforation in the casing 11 as shown in Fig. 7*a*. It will be seen that the elements shown in Fig. 7*a* form a valve which serves as a closure for preventing fluid flow between the interior of the casing 11 and the space 12 between the wall of the bore hole 10 and the casing 11.

In Fig. 8 the punch, which otherwise works in the same way as that shown on Figs. 2–3 and 4, comprises a triangular point 145 in front, which continues by flats 146, and it is slightly conical at the back 147. It is screwed to the end of screw 35′, which is slidably fitted inside a passage contained in the closure member 32′ similar to that in Figs. 2–3 and 4, the screw 35′ being however longer than in the embodiments mentioned above, so that the punch can perforate the casing completely and allow the cement arriving by apertures 33′ to flow around its outer surface (Fig.

8a). As is seen on Fig. 8b, during the return stroke of the perforating and cementing means, the punch returning through the hole which it has perforated jams there due to its conical portion 147. Screw 35' breaks, as in the preceding case, while the punch plugs the hole which it has perforated.

The punch shown in Figs. 9a and 9b is similar to that shown in Figs. 8 and 8a, but it is formed of two parts 148 and 149 both screwed on screw 35', whose weak point is located at the joining of these two parts. When the closure member 32' returns to its normal position, the shaft breaks at this point and only the front part 148 of the punch remains jammed in the casing, while the rear portion is carried back by the perforating and injecting means. This device has the following advantage: after the operation, no part of the punch protrudes inside the casing.

In Figs. 10, 10a and 10b has been shown also a detachable punch 150, which is carried by the perforating and injecting means 151 by means of a flange 152. Both the punch and the perforating and injecting means comprises a central passage 153 for the cement. Inside this passage, a screw 154 having at its front end a valve head 155 is attached by its rear portion to the perforating and injecting means by a nut 156 containing apertures 157 permitting the free passage of the cement. Punch 150 perforates a hole in the casing and jams there, being held in front by shoulders 158 and behind by teeth 159 (Fig. 10a). The cement can then flow out through passage 153. During the return stroke of the perforating and injecting means, valve 155 jams inside punch 150 (Fig. 10b) while shaft 154 breaks at its weak point.

The perforating and injecting apparatus shown in Fig. 11 of the drawings is designed to be lowered into the bore hole on a conventional electrical cable of the type used in electrical well logging operations, for example. In this embodiment, the apparatus comprises a hollow cylindrical member 76 threadedly secured to a body 77, forming a chamber 78 within which a piston 79 is slidably mounted. Above the piston 79 is diposed a quantity of gas 80 under relatively high pressure and below the piston 79 is contained the sealing material 81.

Within the body 77 is formed a laterally extending open-ended chamber 82, the mouth of which is internally threaded at 83 to receive an externally threaded guide member 84 having a bore 85 formed therein. Slidably mounted within the bore 85 is a barrel 86 having a centrally located bore 87 and a flange 88 of relatively large diameter at its forward end. The barrel 86 is provided with a laterally extending flange 89 at its rear end which limits its movement within the bore 85. The barrel 86 is normally retained in the retracted position by means of a pair of coil springs 90 and 91 which are attached to the body 77 at the points 92 and 93 respectively, and to the flange 88 at the points 94 and 95 respectively.

Between the chamber 78 and the chamber 82 is a passage 96 which is closed at its upper end by a suitable closure means 97 for preventing the sealing material 81 from passing therethrough. In the lower portion of the passage 96 is disposed a bullet 98 which is adapted to pierce the closure means 97 to release the sealing material 82 as described in greater detail below.

Within the chamber 82 is disposed a charge of powder 99 which is adapted to be ignited by the passage of current through a filament 100, one end of which is connected to the body 77 at the point 101 and the other end of which is connected through a conductor 102 and a switch 103 to one terminal of a source of current 104, the other terminal of which is grounded at the point 105 at the surface of the earth.

Beneath the chamber 82 and communicating therewith by a passage 105a is a second chamber 82' and associated apparatus for firing a projectile 106' through the casing 11 at a point located about 180° away from the perforation made by the projectile 106. Corresponding parts in the lower firing apparatus are designated by primed reference characters. In practice a plurality of firing apparatuses spaced about the circumference of the body 77 will be used. For the sake of simplicity, however, only two are shown in Fig. 11.

In operation, projectiles 106 and 106' are placed in the rear portions of the bores 87 and 87' in the barrels 86 and 86' and the body 77 is lowered into the casing 11 by means of a cable 106. When the body 77 has been lowered to the depth where it is desired to effect a sealing operation, the switch 103 is closed, causing current to pass through the filaments 100 and 100' and igniting the charges of powder 99 and 99' in the chambers 82 and 82'. The force of the explosion projects the bullets 106 and 106' through the bores 87 and 87' in the barrels 86 and 86' and through the casing 11 as shown in Fig. 11a.

At the same time the force of the explosive gases drives the bullet 98 through the closure means 97 whereupon the pressure of the gas 80 acting through the piston 79 forces the sealing material 81 through the passage 96, the chamber 82 and the bore 87 in the barrel 86 into the space 12 between the wall of the bore hole 10 and the casing 11. It will be noted that the pressure of the sealing material in the chamber 82 will force the flange 88 on the barrel 86 into engagement with the casing 11 against the force exerted by the coil springs 90 and 91, thus preventing leakage of the sealing material into the casing 11 or the seepage of water from within the casing 11 into the space 12. Sealing material will also pass through the passage 105a to the chamber 82' whence it will be forced through the bore 87' in the barrel 86' into the space 12 at another location.

In this embodiment, special means is provided for releasing the gas 80 when the sealing operation is completed, in order to disengage the flanges 88 and 88' on the barrels 86 and 86' from the casing 11. This means comprises a head piece 107 within which is formed a longitudinally extending deadend passage 108. The head piece 107 is mechanically weakened slightly below the upper end of the passage 108 as shown at 109 in Fig. 11 and the cable 106 upon which the apparatus is lowered into the bore hole is secured thereto in any conventional manner. The head piece 107 is enclosed within a cylindrical casing 110 in the upper surface of which is formed an aperture 111 which is smaller in diameter than the diameter of the head piece 107. In the walls of the casing 110 are formed a plurality of passages 112 communicatiing with the liquid within the bore hole 10.

At the conclusion of a sealing operation, the flanges 88 and 88' on the barrels 86 and 86' are in effect locked to the casing 11, so that the body 77 cannot move. Hence, if sufficient tension is applied to the cable 106, it will break off the head piece 107 at the weakened portion 109, permitting

the gas 80 in the chamber 78 to escape through the passage 108, the passages 112 and the liquid in the bore hole 10 to the surface of the earth. The tension in the coil springs 90, 91, 90′ and 91′ is made sufficient to restore the barrels 86 and 86′ to the normal retracted position when this occurs.

In Figs. 12 and 12*a* of the drawings is shown a modification of the apparatus shown in Fig. 11 in which two ingredients of the sealing material may be stored separately and mixed together at the time of injection into the space 12. This modification comprises a body 114 having a cylindrical chamber 115 formed therein within which a piston 116 is slidably mounted. The piston 116 is normally maintained in its uppermost position by means of a coil spring 117, the upper end of which engages the lower face of the piston 116 and the lower end of which is seated in the bottom of the chamber 115.

Above the piston 116 is located a conventional type cartridge 118 which is adapted to be ignited by means of a filament 119, one end of which is grounded to the body 114 at the point 120 and the other end of which is connected to the conductor 102 in the cable 106.

The chamber 115 communicates at its lower extremity with a passage 121 which in turn communicates with a laterally extending chamber 122 formed in the body 114. The chamber 122 has an opening at one end thereof to receive a cylindrical perforating and injecting means 123 provided with a circumferential groove 124 in the rear portion thereof in which is disposed suitable packing material 125 for providing a tight joint. The perforating and injecting means 123 is of the type shown in Fig. 8 and it is provided with a laterally extending passage 126 communicating with a longitudinal passage 127 which in turn communicates with two laterally extending passages 128 and 129 formed in the perforating and injecting means 123. The lower portion of the chamber 115, the passage 121 and the rear portion of the chamber 122 are filled with a pressure transmitting fluid such as oil, which transmits pressure from the piston 116 to the perforating and injecting means 123.

Below the chamber 122 and communicating therewith through a passage 121*a* is a second chamber 122′ having a perforating and injecting means 123′ slidably mounted therein. The apparatus associated with the perforating and injecting means 123′ is like that described above in connection with the perforating means 123 and corresponding parts have been designated by primed reference numerals.

When the perforating and injecting means 123 and 123′ are in the normal retracted position, the passages 128 and 129, and 128′ and 129′ are closed, but when they are moved into the perforating position as shown in Fig. 12*a*, the passages 128 and 129 register with corresponding passages 130 and 131 and the passages 128′ and 129′ with the corresponding passages 130′ and 131′ formed in the lower portion of the body 114. The lower portion of the body 114 is externally threaded at 132 to receive a conventional type bailer 133 which includes an outer cylindrical casing 134 threadedly secured to the body 114, into the lower end of which is threaded a plug 135. Within the casing 134 is formed a second casing 136 which extends from the plug 135 to the bottom of the body 114 in the vicinity of the passage 130. An annular piston 137 is slidably mounted within the casing 134 and a second piston 138 is slidably mounted within the casing 136. Within the plug 135 are formed a pair of passages 139 and 140 which communicate with the interiors of the casings 136 and 134, respectively. The two ingredients comprising the sealing material are placed above the pistons 137 and 138 respectively, in the casings 134 and 136 respectively.

The top of the casing 11 is closed off by means of a closure member 141 provided with a suitable stuffing box 142 which permits the cable 106 to be raised and lowered within the casing 11. The flexible tubing 49, which supplies fluid under pressure from the pumping means 50 is connected to a suitable inlet 143 in the closure member 141 and a conventional pressure indicating instrument 144 is provided for indicating the pressure of the liquid within the casing 11.

In operation, the body 114 is lowered to the approximate depth where the seal is to be made and is brought to rest at that position. The switch 103 is then closed, supplying current to the filament 120 and igniting the cartridge 118. The explosive gases created by the ignition of the cartridge 118 move the piston 116 downwardly against the force of the coil spring 117, increasing the pressure of the oil contained in the chamber 115, the passage 121 and the chambers 122 and 122′, and forcing the perforating and injecting elements 123 and 123′ through the casing 11, as shown in Fig. 12*a*. This brings the passages 128 and 129 in the perforating and injecting element 123 into registry with the passages 130 and 131, respectively, and the passages 128′ and 129′ in the element 123′ into registry with the passages 130′ and 131′ respectively.

Pressure is now applied to the liquid in the bore hole by means of the pumping means 50 at the surface of the earth. This forces the liquid within the casing 11 through the apertures 139 and 140 in the plug 135 and against the pistons 138 and 137, respectively, moving them upwardly and forcing the respective ingredients of the sealing material contained in the casings 136 and 134, respectively, through the passages 130 and 131, respectively, in the body 114 through the passages 128 and 129, respectively, in the perforating and injecting means 123. From thence, the sealing material flows through the passage 127 in the perforating and injecting means 123 and out of the passage 126 into the space 12 between the wall of the bore hole 10 and the casing 11.

In similar fashion, sealing material is forced through the passages 130′ and 131′, respectively, and the passages 128′ and 129′, respectively, to the passages 127′ in the perforating and injecting means 123′. This may be continued until the pistons 138 and 137 have reached their uppermost limits of travel, which event will be indicated by an increase of pressure at the pressure indicating instrument 144.

In order to retract the perforating and injecting elements 123 and 123′ from the casing 11 it is necessary to release the powder gases from the chamber 115. This is done by applying tension to the cable 106 to break the head piece 107, thereby permitting the powder gases to escape through the passage 108 and the passages 112 to the liquid in the casing 11. This permits the coil spring 117 to restore the piston 116 to its normal position, releasing the pressure on the oil contained in the chambers 122 and 122′ and permitting the perforating and injecting elements 123 and 123′ to be withdrawn into their normal retracted positions.

For the sake of simplicity, only two perforat-

ing and injecting means 123 and 123' have been shown in Fig. 12 and described above. In actual practice, there may be a plurality of such perforating and injecting means disposed about the circumference of the body 114, each being actuated by the oil in the chamber 115, and each adapted to receive the sealing material ingredients from the casings 136 and 134.

The apparatus described above in connection with Fig. 12 enables a sealing material to be employed which comprises two or more substances which, when mixed, tend to harden rapidly. For example, a cement which sets relatively slowly might be placed above the piston 137 in the casing 134 and another substance such as, for example, sodium silicate, which when added to cement causes it to harden rapidly, might be placed above the piston 138 in the casing 136. In similar fashion, liquid latex and an acid might be used as the ingredients of the sealing material since they tend to produce a relatively solid substance when mixed together. Other suitable sealing materials will readily suggest themselves to those skilled in the art and they need not be set forth herein.

In Figs. 13 and 13*a* is shown a modification of the apparatus shown in 12 and 12*a*, comprising a special device for controlling the return stroke of the perforating and injecting means.

Punch 160 and perforating and injecting means 161 are similar to those shown in Figs. 7, 8 and 9, that is to say that the punch is adapted to jam in the casing when the perforating and injecting means returns to its normal position, so as to plug the hole previously perforated by this punch. The special device for controlling the return stroke of the perforating and injecting means comprises a chamber 162, of appropriate and rather large dimensions, provided in the body of the apparatus, above the powder combustion chamber 115. The pressure inside said chamber 162 is very low (atmospheric pressure for example) in relation to the pressure inside the bore hole. To obtain this result the chamber is tightly closed before the apparatus is lowered in the bore hole. For controlling the return stroke of the injecting means, this chamber is brought into communication with the powder combustion chamber. In this way the combustion gases then expand in the said chamber until a pressure is reached which is much lower than the pressure of the mud inside the bore hole. At this moment, due to this difference of pressure, the perforating and injecting means 161 is thrust inside chamber 122 carrying with it punch 160 which jams in the casing. The shaft of the punch then breaks, and the perforating and injecting means continuing its movement returns completely inside chamber 122 (see Fig. 13*a*).

The device for bringing chamber 116 into communication with chamber 162 may be of any type. In the figure, shaft 163 which is attached to the supporting cable 106 comprises a weak point 164 and is chambered out in its centre 165. The upper end of said shaft 163 goes through a flange 166, integral with a plate 167 which closes the upper part of the chamber 162, said upper end being located underneath another chamber 168, communicating with the inside of the well through holes 169. A rubber sleeve 170 tightly joins shaft 163 and flange 166. After the perforation followed by cementing, which is brought about by the ignition of the powder in chamber 115, the device is brought back to its normal position by means of strong traction on the cable, which has the effect of breaking shaft 163 at the level of the weak point 164. This brings chamber 115 into registry with chamber 162 by means of passage 165 and the perforating and injecting means then returns to its normal position as indicated above. The apparatus remains held by the cable by means of the upper end of shaft 163 abutting against the cover 171 of the apparatus.

It will be apparent from the foregoing that the invention provides novel methods and apparatus for producing a highly effective seal economically and in a short space of time. By virtue of the fact that the sealing material is injected through the same means which perforates the casing, sealing operations may be carried out more rapidly and with greater ease than has been possible heretofore.

MARCEL SCHLUMBERGER.

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BY A. P. C.

M. SCHLUMBERGER
WELL CO DITIONING APPARATUS
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Serial No.
405,024
8 Sheets–Sheet 1

Fig.1.

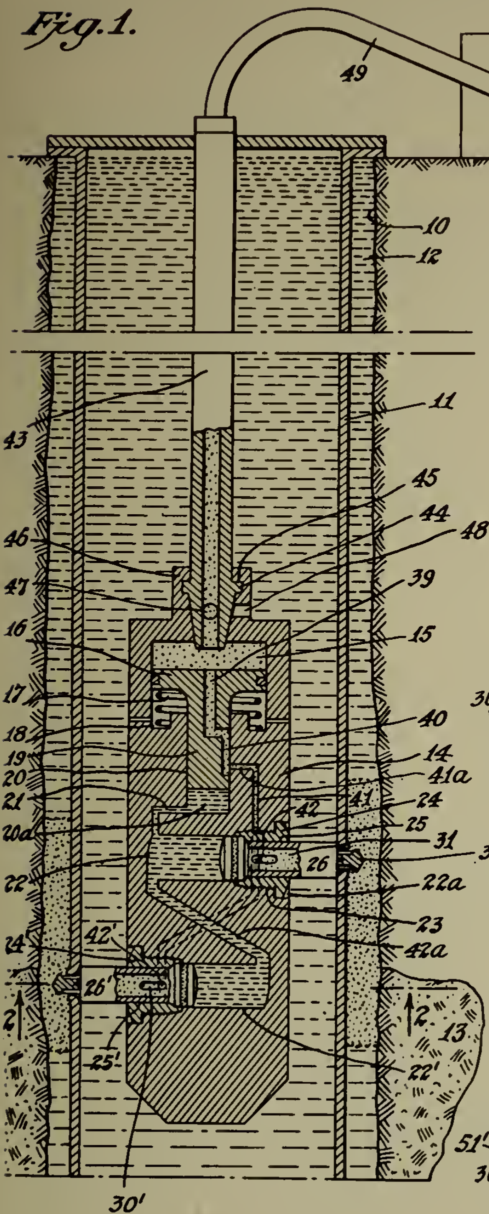

Fig.2.

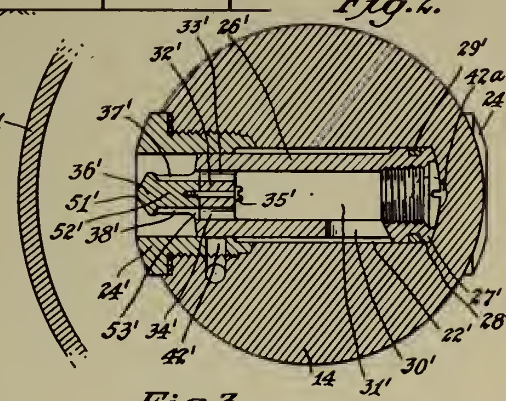

Fig.3.

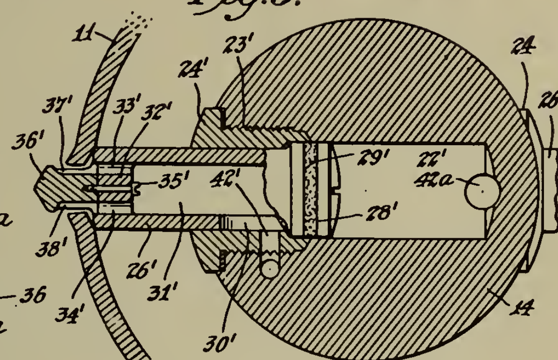

Fig.4.

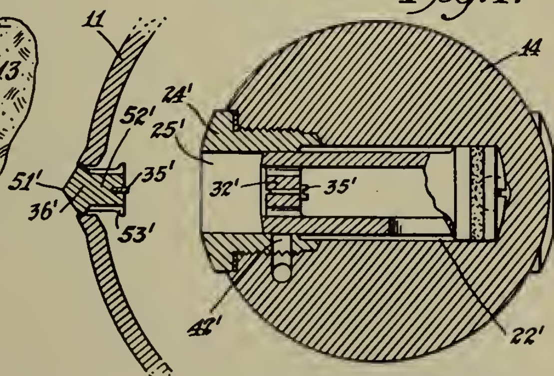

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Fig. 5.

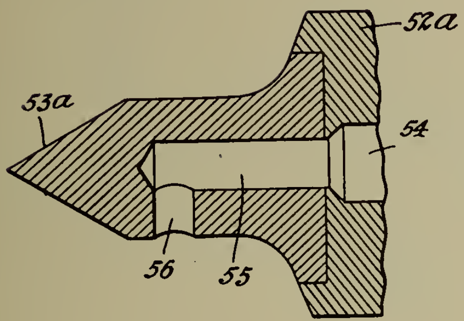


Fig. 6.

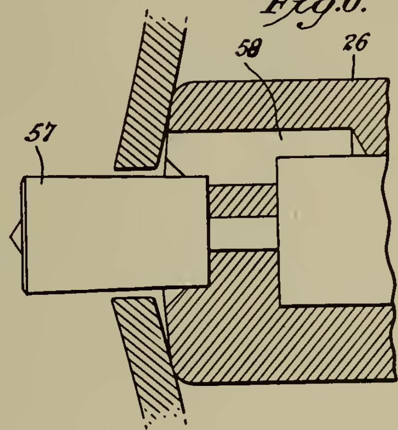


Fig. 7.

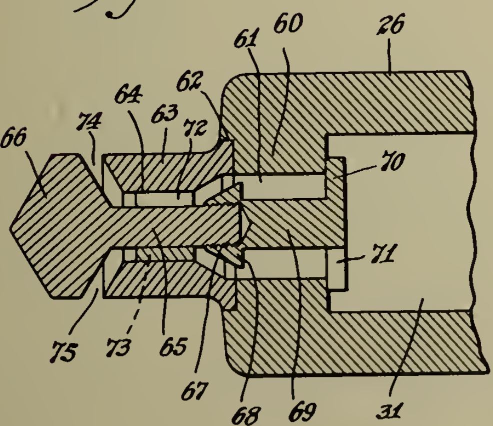
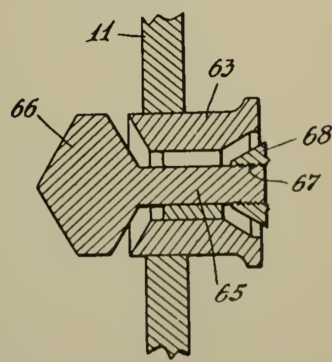


Fig. 7a.



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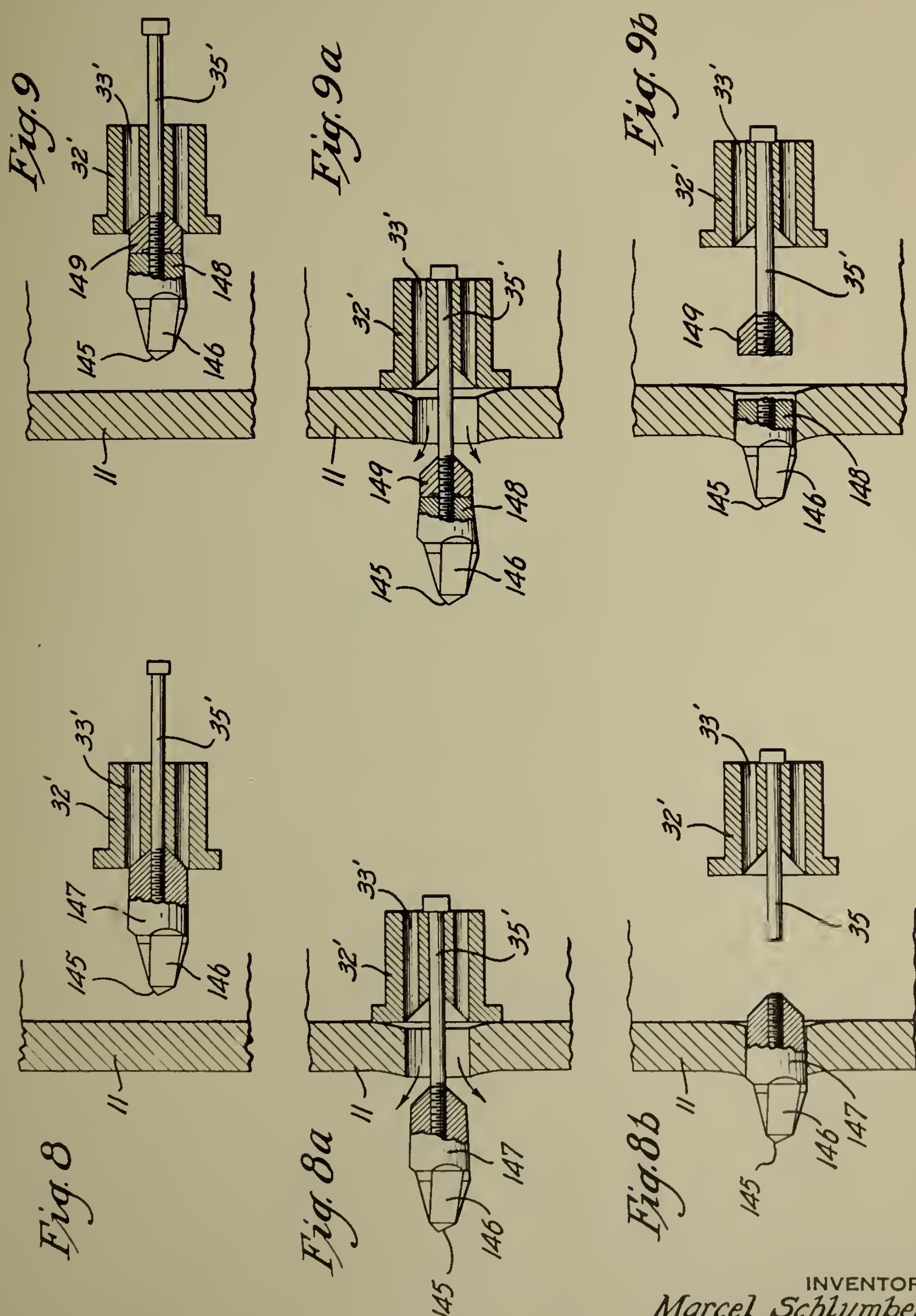

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Fig. 10

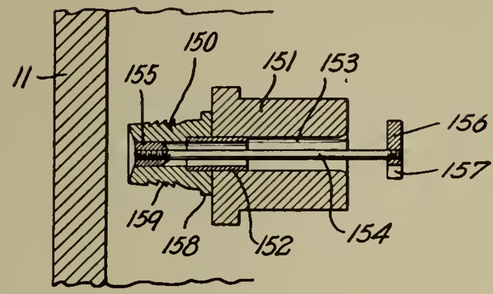


Fig. 10a

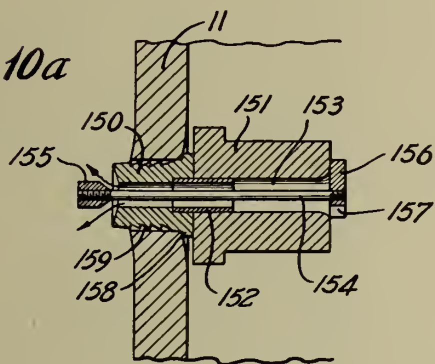
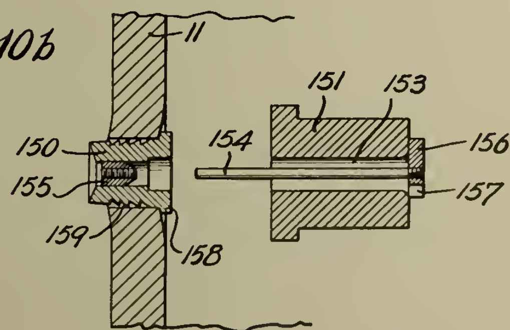


Fig. 10b



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405,024

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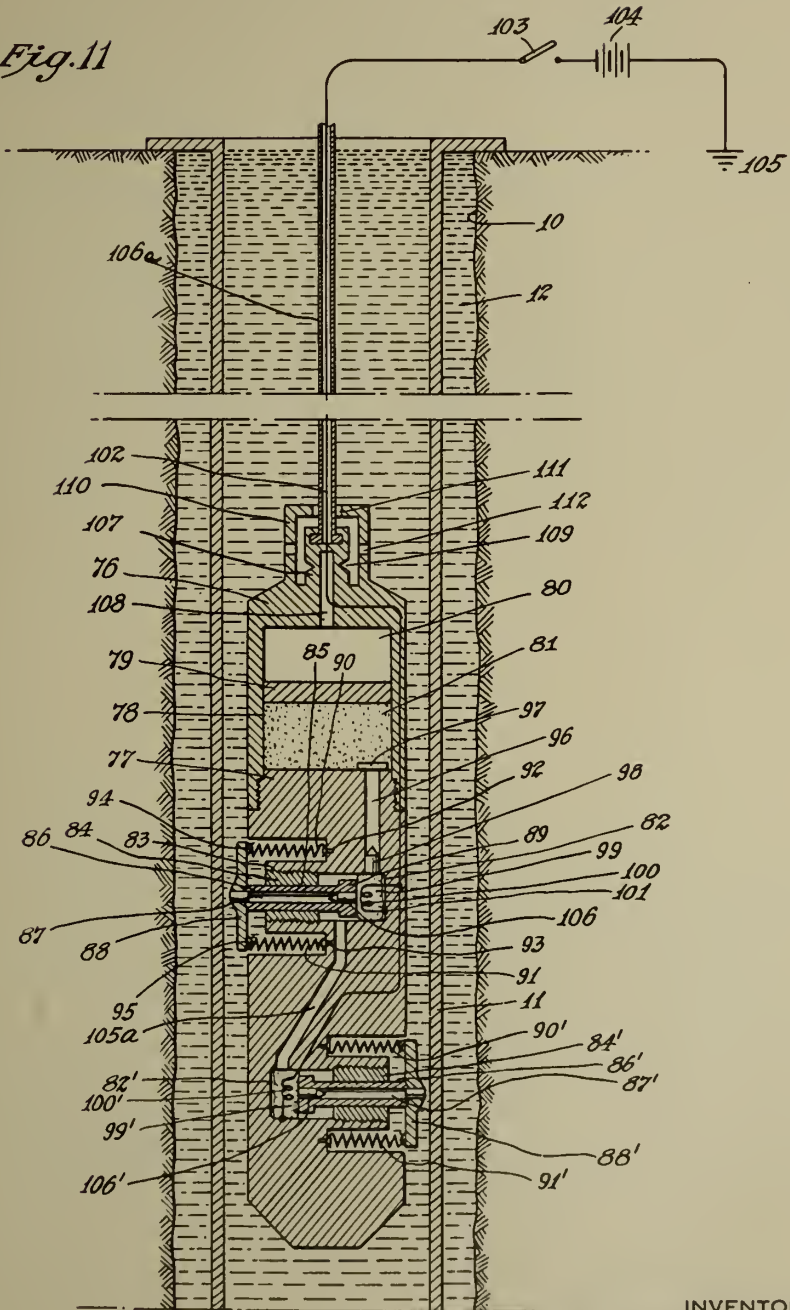
Fig. 11



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BY A. P. C.	Filed Aug. 1, 1941	8 Sheets-Sheet 6

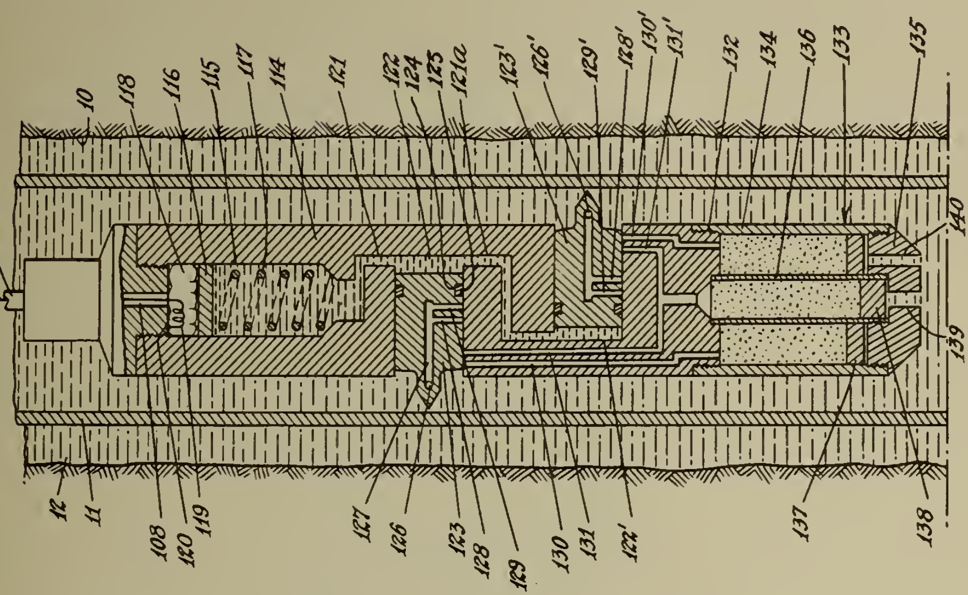

Fig. 12

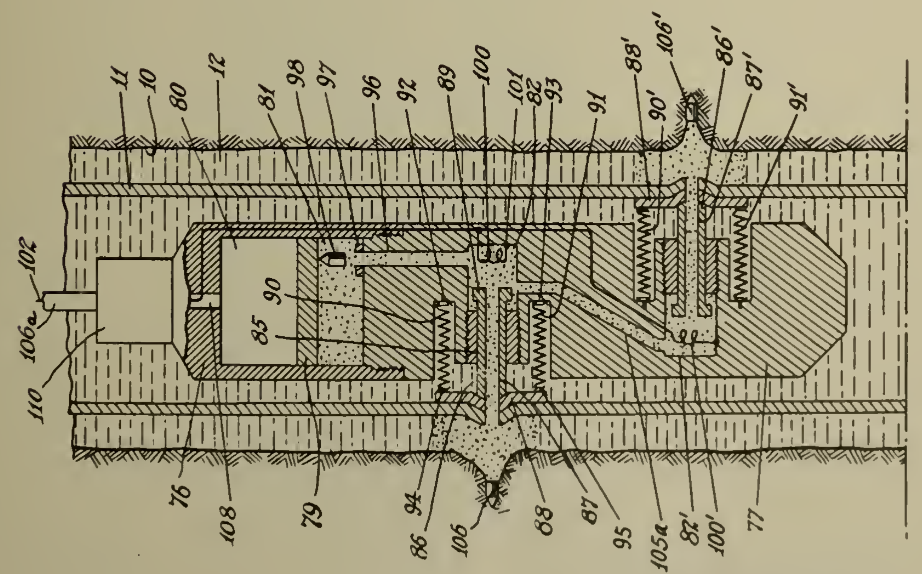

Fig. 11a

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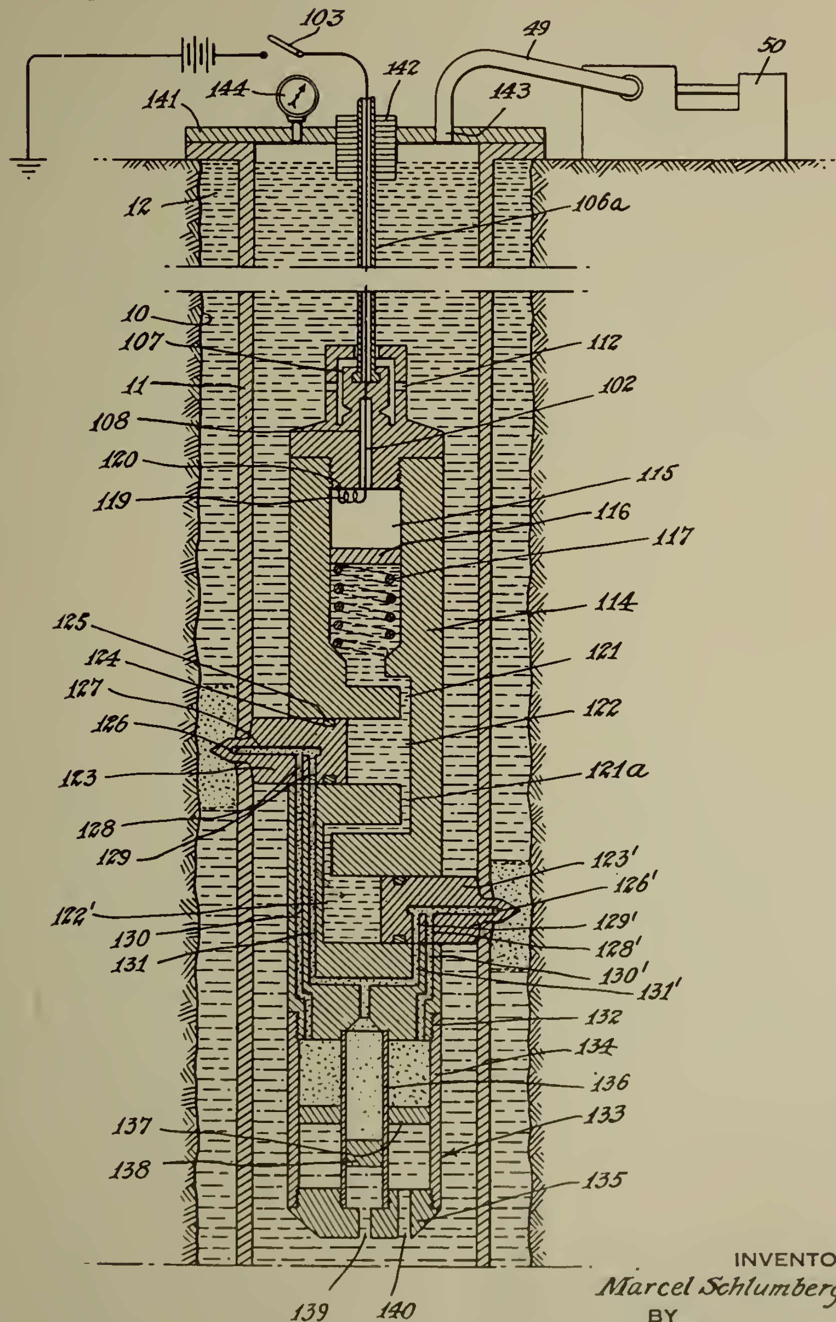
Fig. 12a



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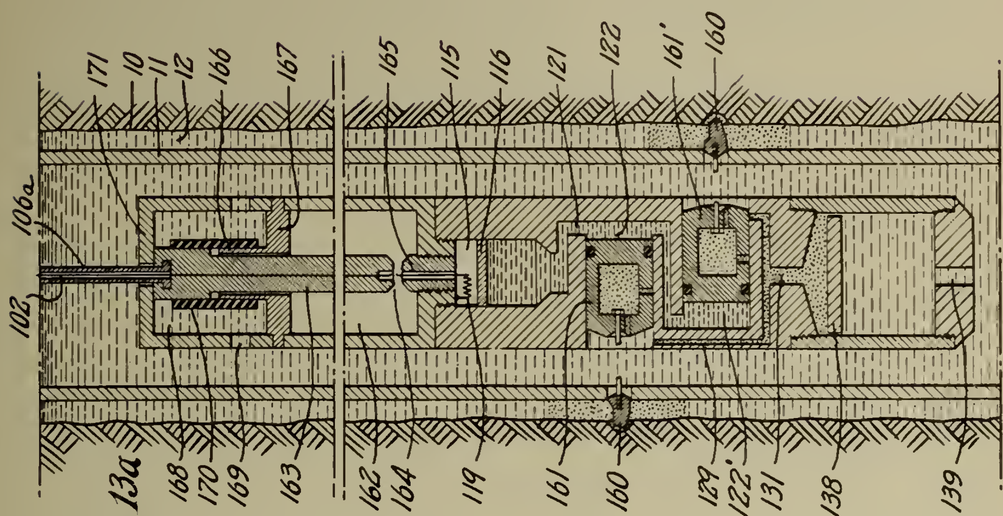

Fig. 13a

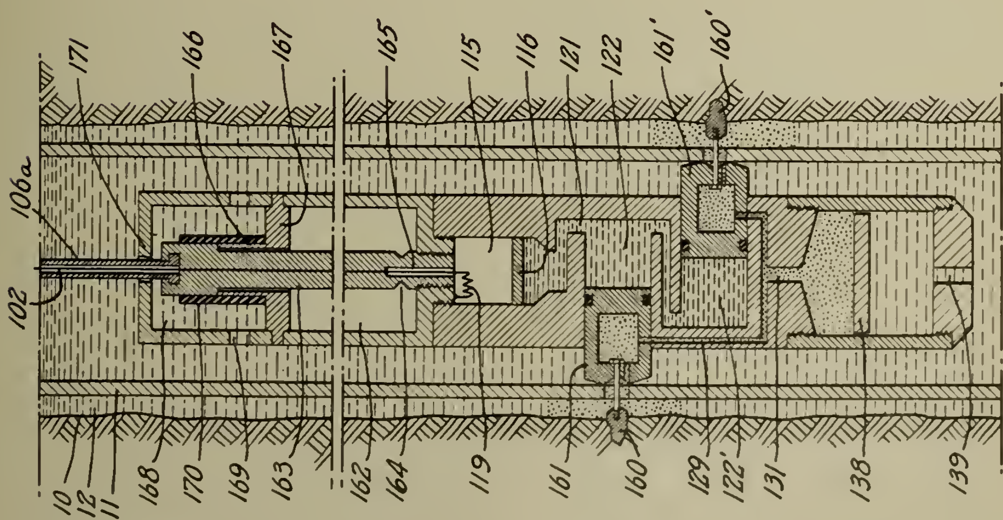

Fig. 13

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ALIEN PROPERTY CUSTODIAN

METHODS OF TEMPERING GLASS OBJECTS, PARTICULARLY PLATE GLASS

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Application filed August 4, 1941

The present invention relates to methods of tempering glass, particularly glass sheets, which consists in bringing the object to be tempered to a temperature close to that of softening and subjecting it, in this state, to sudden cooling by means of jets of air or other cooling fluids projected on its surface, or by immersion in cooling liquid baths.

In most cases, but more particularly in tempering thin glass sheets, good tempering results require that the cooling be strictly controlled from the instant the object leaves the heating zone, that is, that rational or predetermined cooling for tempering should not be advanced and counteracted by chance cooling not under control of the operator.

It has frequently been observed in this connection that thin glass sheet, which leaves the heating zone and passes through the open air for a distance before being subjected to sudden cooling, often breaks spontaneously.

Particularly, sheets, when very thin, should be subjected to intense preliminary heating, so that the sudden cooling can produce in the object, not withstanding its slight thickness, the marked differences in tension which characterize the tempering. The sheet leaving the heating zone in an extremely plastic state by reason of its high temperature should be passed to the cooling members with precaution, that is, sufficiently slowly so that the transportation will not produce deformation of the plastic mass. However, during this transportation at a slow rate, the sheet undergoes chance or accidental cooling of relatively great duration and which is not under control.

Moreover, if, for the purpose of treating the sheet with caution it is left in a fixed position during the entire treatment, the cooling members must be rapidly substituted for the heating members in front thereof, which, by reason of the material importance of these apparatus, can not be done without complicating the plant.

By another method, endeavor has been made to protect the object from untimely cooling between the stages of heating and sudden cooling, by providing at the discharge point of the heating members a zone between the cooling members which constitutes a passageway, at the interior of which the sheet can reach the blowing point while being protected from the movements of the air in the shop. This passageway, made of sheet metal, is removed from its initial position, as soon as the sheet has reached the blowing point and at this moment, uncovers the blowing members which may then enter into immediate operation. In practice, however, this arrangement has not proven capable of maintaining the sheet in the thermal state necessary for good tempering for a sufficient period of time because notwithstanding the presence of this protective zone, the plate undergoes considerable cooling.

The present invention is designed to greatly reduce, if not to eliminate, the cooling of the plate between the end of the heating and the beginning of the sudden cooling, while providing the desirable time interval between these two operations.

It consists in maintaining the object, for example, a glass sheet, from the time of its discharge from the furnace and up to the moment in which the cooling members, for example, the blowing elements, enter into operation, between protective surfaces, which by their nature or their temperature, are capable of forming screens to prevent loss of heat by radiation from the sheet, or wherein these surfaces act by reflection to throw back the heat on the sheet which the latter has radiated, or whereby they exert a suitable inherent radiation which neutralizes the radiation of the sheet.

Applicant has, in fact, been able to demonstrate that when a glass sheet has a temperature near its softening point it has great capacity for cooling by radiation, and that this cause of cooling predominates over all other losses of heat, for example, on contact of the sheet with the surrounding air.

This consideration explains the inefficiency of known apparatus as previously described and formed with a passageway of ordinary metal sheet, this material being incapable of preventing losses of heat through radiation from the sheet which is almost at its softening point.

Among the surfaces which, by their nature, are capable of reflecting the heat radiated by the object, some have this property only when they are polished to a high degree, and should necessarily be maintained in this state, such for example as sheet iron, or steel; other surfaces are effective by their very nature, but require careful upkeep to remain unaltered, for example copper. Other metals, on the contrary, are effective without special precautions. Such is the case with aluminum which can be used practically in unpolished state, for example in the form of a coating projected or applied to an ordinary sheet metal body. It is to be understood that use may also be made of surfaces with silvered coatings, with certain precautions for retaining their great reflective capacity. In general, the

reflecting capacity considered in the present case is the power of reflecting chiefly the rays emitted by an object carried to a temperature close to its softening point and which are chiefly heat rays.

On the other hand, the protective properties of the surfaces utilizable according to the invention may be due to the fact that they are brought to a temperature close to the softening point of the glass; this temperature of the protective surfaces may be slightly higher than the temperature of the sheet, the essential condition being only that the temperature of these surfaces remain sufficiently constant during the time interval to be provided between the final instant of heating and the initial instant of the cooling, as by blowing.

Use may also be made of surfaces having both of the two above characteristics simultaneously, that is, high reflecting power and suitable temperature.

With respect to the structure, particularly the relative position of these surfaces with respect to the blowing and heating members, it is to be noted that these surfaces may, according to the case, be fixed or movable with respect to these members. In any case it is preferable that the protective surfaces be continuous and parallel with the object and spaced slightly therefrom.

Furthermore, according to an important feature of the invention, certain elements of these surfaces may be identified with the surface of the cooling members, for example in the case of cooling by blowing, and are thus capable of protecting the object from cooling, while the object is located between these members before the cooling is started.

These different characteristics as well as the various possibilities of carrying out the invention will appear from the following specification relative to three tempering plants according to the invention, which are illustrated in the accompanying drawing and wherein:

Fig. 1 is a vertical sectional view of one embodiment of the invention.

Fig. 2 is a vertical sectional view of another embodiment of the invention.

Fig. 3 is a vertical sectional view corresponding to Fig. 2 showing the parts in different operative positions, and

Fig. 4 is a vertical sectional view of a third embodiment of the invention.

According to the exemplary embodiment shown in Fig. 1 the heating zone **1** is connected with the cooling members **2**, formed by two parallel casings provided with perforations for blowing the air, by a metallic sleeve **3**, the inner surfaces of which are covered with a layer of reflecting metal, such as the aluminum coating **4**. The inner surface of each casing **2** is itself provided with a similar coating **4**a, except of course for the blowing orifices **5**.

An advantage of this construction consists in the fact that the existence of protective surfaces does not make it necessary to increase the distance between the origins of the jets or jet openings and the sheet. Thus, this embodiment permits of permanently giving this distance the minimum value compatible with the thickness of the plate F and the members which support it, such minimum value being favorable to good tempering. The supporting members are indicated by the tongs suspended from the cable **10**, which may be reeled in a conventional manner.

Figs. 2 and 3 show a modification wherein the reflecting surface consists of two movable plates **6**, arranged in pairs, the inner surfaces of which have great reflecting capacity.

At the initial instant of the transfer period these plates occupy the position shown in Fig. 2 and at which time their lower edges are immediately adjacent the discharge opening of the furnace I. Starting from the instant in which the lower edge of the glass sheet passes beyond this opening, and during the entire transfer of the sheet up to the blowing casings **2**, these plates, carried by the suspension cables **13**, move synchronously with the sheet, and when the latter reaches its blowing position and is fixed immovably at that point (Fig. 3) these plates continue, but much more rapidly, their movement in the same direction, so as to disengage the sheet completely and allow the cooling air jets free access thereto.

It is, of course, apparent that the plates may be of sufficient height so that they extend over the entire length of the path of the sheet glass, and in such case there is no use to move them during the transfer, their withdrawal taking place then only at the instant in which the sheet is fixed in the cooling position.

By reason of the mobility of the reflecting plates **6**, it is possible, with a spare set thereof, to keep them in good condition easily, particularly to maintain their high polish.

According to the construction shown on Fig. 4, use is made of protective plates which, according to a characteristic feature of the invention, opposes radiations of the glass sheet F, by reason of the fact that they are carried to a temperature near that of the sheet on its exit from the furnace I.

For this purpose the paired plates **7**, the arrangement and movements of which relative to the sheet and to the heating and cooling members are similar to those described with respect to Figs. 2 and 3, are carried, during the time intervals in which they are inactive, into a heating zone **8** where they acquire the desired temperature.

Fig. 4 shows the assembled apparatus in the position which the various members occupy at the moment in which the sheet is on the point of passing from the heating furnace I. During the heating and up to this moment the upper opening of this furnace is closed by two hinged doors **9**, the adjacent edges of which are provided with narrow grooves, notches, or the like, for the passages of the cables **10** supporting the glass sheet F. Before the withdrawal of the glass sheet from the furnace these two doors are raised so as to occupy the position shown in broken lines at **9**a, at the interior of the protective plates **7**. By reason of the action of the heat to which these doors are subjected while they close off the furnace I they themselves constitute the elements protecting the sheet from cooling through radiation during the ascent of the latter, the same as the plates **7**.

Instead of heating the protective plates by means of the auxiliary furnace **8** the heating furnace I can, in certain cases, be utilized therefor. In this case the protective plates may remain in this furnace I together with the object.

As in the case of Figs. 2 and 3 means are provided to operate very rapidly, at the moment in which the blowing is to begin, for withdrawing the protective plates from the field of action of the blowing members **2**.

In most cases the invention is carried out so

that the protection exerted by the plates actually extends over the entire surface of the glass sheet, and in such case the plates are provided with a larger surface than that of the glass sheet; but it is also possible, particularly to protect the vicinity of the edges as well as the edges themselves of the glass sheet, to provide auxiliary protective plates extending perpendicularly to the plane of the glass sheet and opposite the edges thereof. The assemblage of protective plates then forms a more or less closed space encompassing the entire glass sheet.

Such an arrangement is shown by way of example on Figure 4, on which the main protective surfaces 7 are interconnected by an end 11 and the lateral walls 12, the assemblage thus constituting a kind of casing of which only the lower part is left open for the passage of the glass sheet; but it is to be understood that this latter opening may itself be provided with a kind of door, hinged for example, which opens at the moment of the passage of the glass sheet and then closes. By thus constructing the protective walls in the form of a casing closed on most of its surfaces, movements of the air around the glass sheet are avoided, particularly the ascending movement of hot air.

It is to be understood that the invention is also applicable in cases where it is desired to protect only certain parts of the object from cooling by radiation. In this case the protective surfaces are given a form and contour such as to exert action only on the parts to be protected.

All these devices, which moreover can be combined, are adapted to maintain the glass sheet, at least in the desired parts, in the thermal state which is had at the end of the heating, and this for a sufficient interval of time so that it is no longer necessary to operate very rapidly either for transferring the glass sheet to the blowing members, or for substituting the latter for the heating members. It is thus possible to avoid subjecting the glass sheet to more or less sudden movement capable of producing deformations, or of moving relatively heavy members rapidly.

The manufacture of tempered glass sheet is thus facilitated and it is possible to realize under practical conditions the tempering of very thin glass, for example 3 mm. thick and less.

Summary

This invention relates to:

(1). Improvement in methods of tempering glass objects, particularly glass sheet wherein the object, after having been brought to a temperature close to the softening point, is subjected to sudden cooling, said improvements consisting in maintaining the object, from its exit from the furnace and up to the moment in which the sudden cooling enters into action, between protective surfaces which, by reason of their nature or their temperature, are capable of forming screens to prevent heat losses by radiation from the object, or wherein the surfaces act by reflection to pass back the heat radiated from the object, or whereby they exert a suitable inherent radiation which neutralizes that of the object.

(2). Various methods of carrying out such improved process having the following characteristics alone or combined:

(*a*). The protective surfaces are selected from those to which a high degree of polish imparts the capacity of reflecting heat rays;

(*b*). These protective surfaces have the capacity of reflecting heat rays by reason of the character of the substance forming these surfaces, for example aluminum;

(*c*). The surfaces are brought to a temperature close to that of the object on its exit from the furnace, this temperature being communicated to said surfaces during periods in which they do not protect the object, or by remaining in an auxiliary furnace, or by being introduced into the furnace which heats the object;

(*d*). Where the objects are suddenly cooled by blowing certain walls of the blowing members are constructed so as themselves to form screens for preventing heat losses by radiation from the object;

(*e*). The action of the protective surfaces is limited to certain regions of the object.

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PUBLISHED

JUNE 1, 1943.

BY A. P. C.

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METHODS OF TEMPERING GLASS OBJECTS, PARTICULARLY PLATE GLASS

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Serial No. 405,411

2 Sheets-Sheet 1

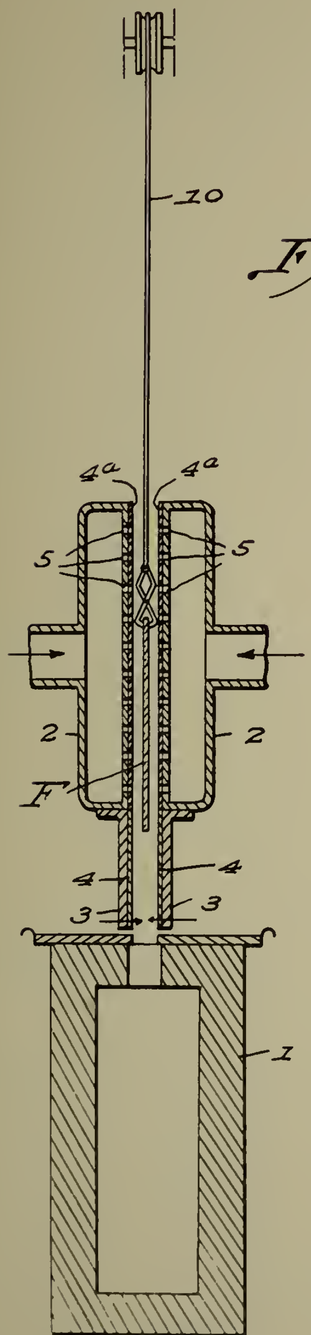

Fig. 1.

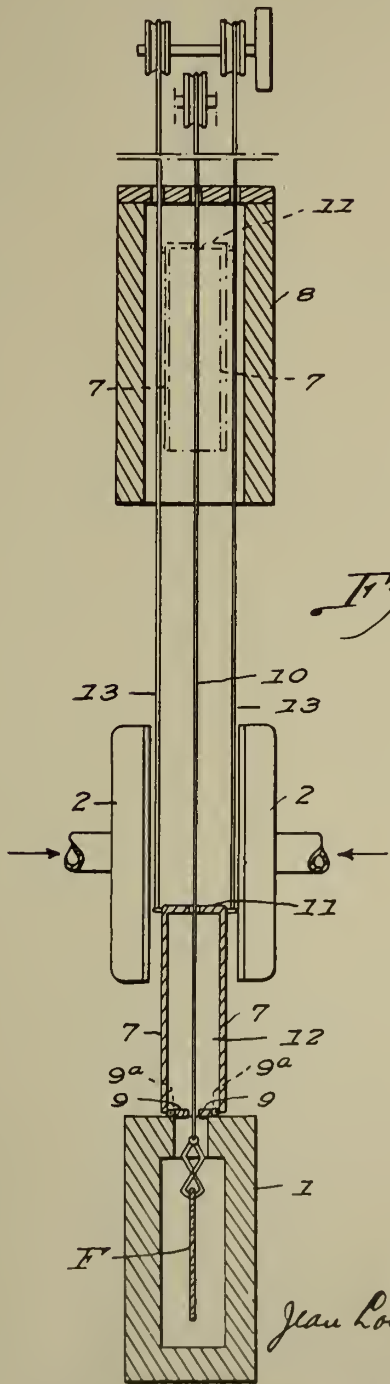

Fig. 4.

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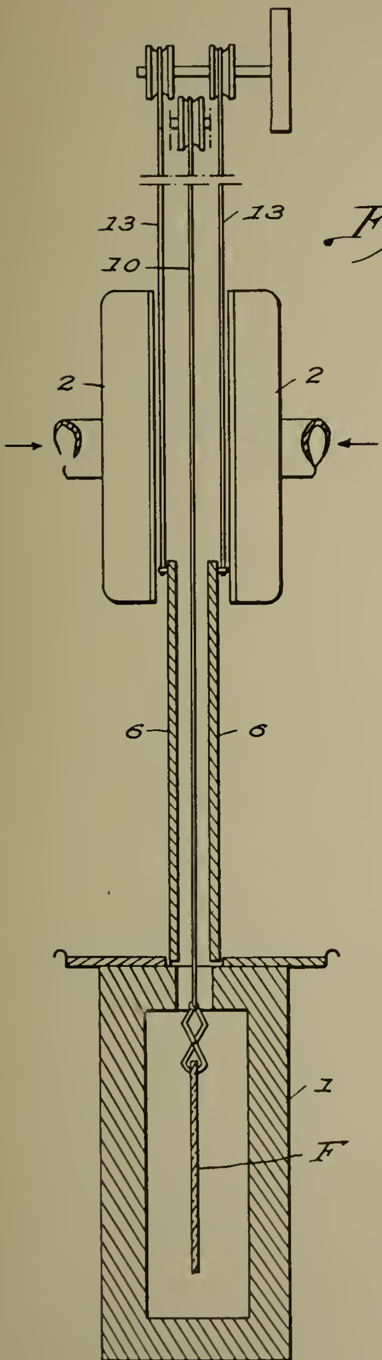

Fig. 2.

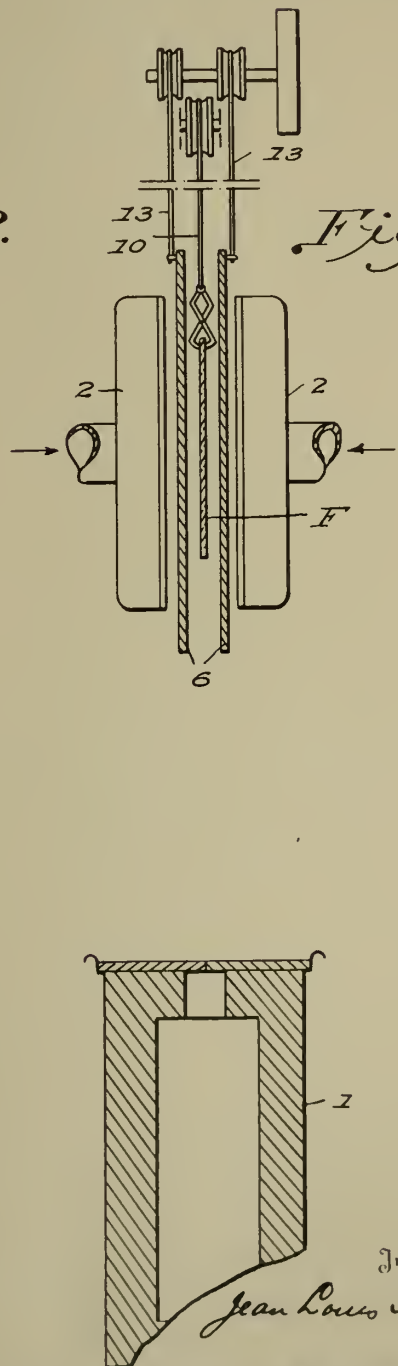

Fig. 3.

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ALIEN PROPERTY CUSTODIAN

DEVICE FOR RETAINING A RESERVE SUPPLY OF FUEL IN FUEL TANKS, PARTICULARLY OF MOTOR-CARS

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Application filed August 6, 1941

It is extremely difficult to provide in fuel tanks accommodated at the rear of motor-cars an appropriated and reliable device rendering possible to separate from the main quantity of fuel a predetermined part as a fuel reserve, so as to have after the contents of the main fuel tank being consumed at least as much fuel as a supply as to be able to reach the nearest filling station. Hitherto all the mechanical devices have been found to demand too much attention and to be too expensive, what caused introducing electrical measuring devices the manner of action of which may be observed at the instrument board. However, those devices, too, did not bring advantages as to justify the relatively high initial costs. The most important thing to be required from such a mechanism, is an indication as exact as possible, an object which cannot always be attained, particularly, with electrical measuring devices.

All the drawbacks and inaccuracies existing in mechanically operated fuel reserve tanks or electrical measuring devices are eliminated by the simple and cheap device as described in the following:

According to the invention there is provided in the lowest place of the fuel tank a hemispherically or the like shaped receptacle or cup the top of which is open and into which the fuel drain pipe extends. This receptacle or cup is swingably mounted in the fuel tank. On the one side the upper edge of this cup resembling receptacle leans under the constant tension of a spring attached to the opposite side against a stop, whereby the open side is always horizontal.

As long as the fuel tank is filled with fuel beyond the upper edge of the cup, fuel may be withdrawn from the tank through the drain pipe. As soon, however, as the fuel level has descended to the upper edge of the small receptacle, and its contents, too, have been exhausted, fuel feed will cease and, by this, the driver will obligatorily be reminded of his having but a relatively small quantity of fuel still in the fuel tank and of the necessity of taking care of refilling the fuel tank. Yet, he will be able to continue his ride at will still during a predetermined space of time, as upon swinging away the cup the fuel drain pipe may withdraw from the remainder of fuel in the tank the fuel which the engine requires for its drive. If the driver gets the fuel tank refilled, when the next opportunity offers itself the cup will, according to the invention by means of a float, be replaced into the initial position. This automatical taking back of the cup represents an important discharge for the driver as the reversal can never be forgotten.

In the accompanying drawing the invention has been represented schematically in a section through the fuel tank. In this drawing a is the fuel tank, b the swingable mounted cup which is suspended in some way or other, e. g., in two jacks c, and turns on the point d. The cup is pulled to the stop e by means of spring f. Stop e is elongated upwardly and serves with its upper extremity as a support for arm k of float l to turn in this bearing. Arm k comprises a cambering k' which is designed as to snatch under the edge of cup b whenever this latter is turned into the dotted position. The ascending or drain pipe h leads to the lowest place of the cup b so that upon tipping the latter the fuel supply may be exhausted from the main tank a. The gasoline filler neck is designated by i. On the fuel tank a there is provided an electromagnet q the core of which is connected by means of a rope or the like with the cup.

The manner of action of the device according to the invention may be described to be as follows:

The driver will be aware, by the running of the engine, of the fuel level sinking to the upper edge of cup b and of this latter being emptied. Upon operation of a switch m the electromagnet l pulls into itself owing to the current taken from the battery n the iron core o, whereby by way of the rope p connected with the latter the cup b is pulled into the dotted position. The cambering k' of the float arm k snatches under the edge of the cup b and holds the same in this position. While the tank being replenished the float will rise as well as the fuel level and release at a suitable height the edge of cup b, whereby the same will be withdrawn by means of spring f into its horizontal position.

WERNER STROBEL.

PUBLISHED

JUNE 1, 1943.

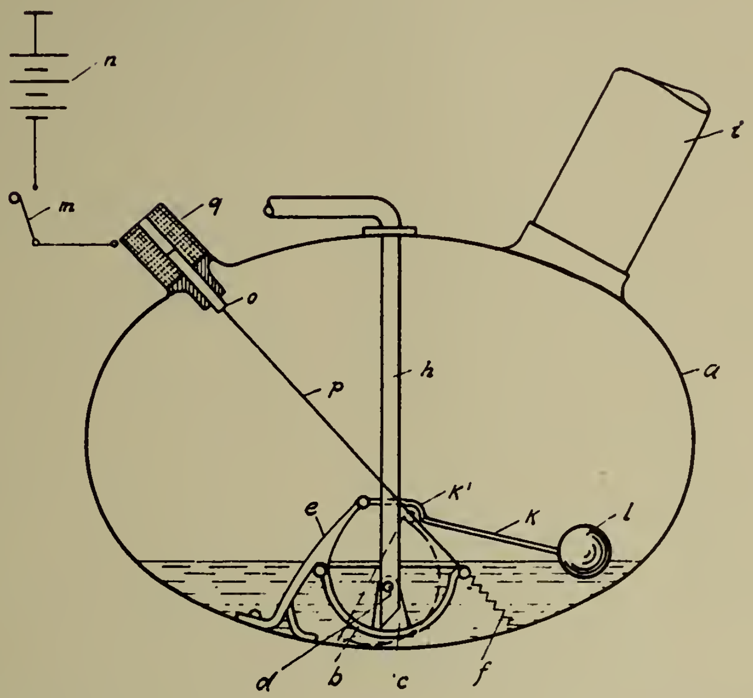
BY A. P. C.

W. STROBEL

DEVICE FOR RETAINING A RESERVE SUPPLY OF FUEL IN FUEL TANKS, PARTICULARLY OF MOTOR-CARS

Filed Aug. 6, 1941

Serial No. 405,598



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Published June 1, 1943

Serial No. 406,374

ALIEN PROPERTY CUSTODIAN

LOCKING DEVICE FOR SCREWED PIPE JOINTS

Ernst Rüdiger, Berlin, Germany; vested in the Alien Property Custodian

Application filed August 11, 1941

The invention relates to a locking device for screwed pipe joints, and its object is to secure the cap nut connecting the end of the pipes in every position of the cap nut. Another object of the invention is to enable the locking device to be easily fixed at difficultly accessible places and to be always used again after it has been taken off.

Accordingly, the locking device provided by the invention substantially consists of two hooks surrounding the ends of the pipes at the sides of the cap nut, a bridge passing over the cap nut and connecting the hooks, and means for pressing the hooks against the ends of the pipes to be connected.

Various constructional forms of the device according to the invention are illustrated by way of example in the accompanying drawing, in which like reference numerals indicate like parts, and in which:

Fig. 1 is a perspective view of a pipe connection with a cap nut and a locking device;

Fig. 2 is a perspective view of the locking device;

Fig. 3 is a side view of a pipe bend connection with a locking device;

Fig. 4 is a perspective view of a pipe connection with a cap nut and a locking device made of wire;

Fig. 5 is a perspective view of a locking device according to Fig. 4; and

Fig. 6 is a perspective view of another constructional form of a locking device.

Two pipe ends 2—2 are connected in usual manner by a cap nut 1. In order to perfectly secure this cap nut in every position, a novel locking device is provided. This locking device consists, according to Figs. 1 to 3 and Fig. 6, of a stamped piece of sheet metal bent in such a manner that two hooks 3 are formed perpendicular to a bridge 5, the length of the bridge 5 exceeding somewhat the height of the cap nut 1, and the bridge 5 being adapted to have a free position over the circumference of the cap nut. This locking device is simply pushed over the cap nut 1 so that the hooks 3 surround the ends 2—2 of the pipes at the sides of the cap nut 1. In order to be able to tightly press the hooks 3 against the walls of the pipes and thereby to secure the cap nut 1 in its position, an elastic blade 6 is formed, which presses against the cap nut 1 below the bridge 5 and thereby secures the hooks 3 to the ends of the pipes. Instead of the blade 6, there may be provided in the bridge 5 a tap hole strengthened by a collar 15 through which a headless screw 7 or the like may be screwed against the circumference of the cap nut 1, whereby the bridge 5 is lifted and the hooks 3 are pressed against the walls of the ends 2 of the pipes. But the screw 7 may be provided in addition to the blade 6, in which case the screw 7, when being tightened, presses via the blade 6 against the cap nut 1 (Figs. 3 and 6).

In order to prevent the hooks 3 from slipping, the inner sides of the hooks 3 are provided with teeth 4 (Figs. 1 and 2) or with a rough surface. But the ends of the hooks may also be provided with a rough lining causing a high friction, such as fibre, asbestos, caoutchouc, or synthetic caoutchouc, as for example in Fig. 6. According to this Fig. 6, one of the hooks 3*a* is provided with a flange 13 produced by the cutting 11, a strip 12 of fibre, asbestos, or some other elastic material being inserted in the flanged part so as to project over the inner edge of the hook 3*a* and to bear against the wall of the pipe. In another constructional example, the hook 3*b* in Fig. 6 is provided with a rubber coating, particularly of synthetic rubber, which is extremely suitable because it is not affected by oil, petrol and heat.

The locking device described above may be easily removed by pressing down and pushing back the bridge 5, after having loosened the screw 7, if the latter is used. The removal of the locking device may be facilitated by providing the bridge 5 according to Fig. 6 with a flange extension 10 on the open side of the hooks so that, by pressing on this extension 10, the hooks 3 are tipped and may be removed.

Another constructional example is shown in Figs. 4 and 5, where the locking device consists of two hook bows 3 made of wire, which are bridged over at both ends by bridges 5 and 5*a*. A locking bow 8 engages the bridge 5 and is provided with two elastic angular legs 9 bearing against the circumference of the cap nut and tending to press the bow 8 in outward direction. This locking device is operated by pushing the two hook bows 3 at the sides of the cap nut 1 towards the two ends 2—2 of the pipes and then pressing down the locking bow 8 until its free end snaps over the bridge 5*a*. When pressing down the locking bow 8, it is advantageous to grip the bow 8 together with the bridge 5*a* with flat pliers, by means of which these parts are drawn together. Also in this construction, the inner side of the hook bows 3 may be provided, for example after pressing flat the hooks 3 (Fig. 4), with teeth 4, or the hooks 3 may be given a zigzag shape, as shown in Fig. 5. In this case there may also be provided other coatings with high friction on the hook portions adjoining the pipe walls, which coatings, on the one hand, ensure a good adhesion and, on the other hand, prevent the pipe ends from being damaged, if they consist of a soft material, for example aluminium.

ERNST RÜDIGER.

PUBLISHED JUNE 1, 1943. BY A. P. C.

E. RÜDIGER

LOCKING DEVICE FOR SCREWED PIPE JOINTS

Filed Aug. 11, 1941

Serial No. 406,374

Fig.1

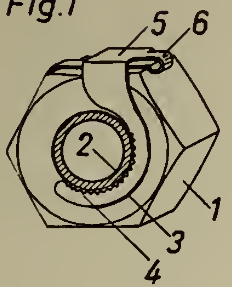


Fig.2

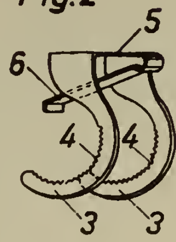


Fig.3

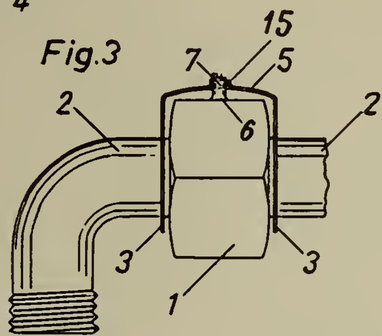


Fig.4

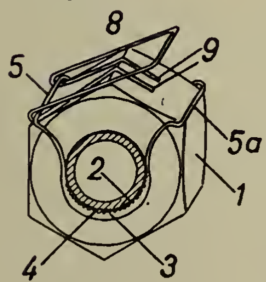


Fig.5

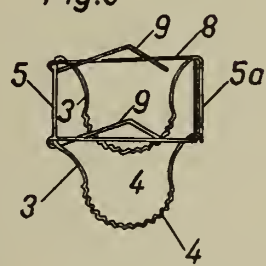
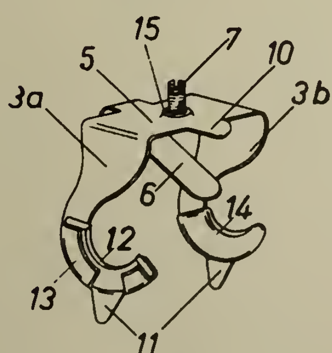


Fig.6.



Inventor
Ernst Rudiger
By

Published June 1, 1943

Serial No. 406,948

ALIEN PROPERTY CUSTODIAN

METHOD OF PRODUCING TOOLS

Friedrich Wenzel, Berlin - Siemensstadt, Germany; vested in the Alien Property Custodian

Application filed August 15, 1941

This invention relates to a new method of producing tools of the class of milling hobs, milling cutters, gear cutters, taps, dies and the like, as disclosed, for example, in the co-pending application, Ser. No. 294,004, filed September 8, 1939, of which the present application is a division.

A brief discussion of certain aspects that must be considered in connection with this method is rendered below so as to support the detailed explanations which are to follow. A milling cutter or milling hob for cutting gears, such as spur gears and the like, may be taken as an example for illustrating these aspects.

Gears of this type, with any given tooth shape and size, and also worm gears, spiral gears and herringbone gears of any width and with different angles of inclination of the teeth with respect to the axis on the one hand and a variety of profiles on the other hand, may be manufactured by milling without the necessity of reclamping the work in position. The gears are cut in such a manner that either the cutter is shifted in parallel relation to the axis of the gear, or the work passes the cutter in axial direction. The cutter and gear may rotate like two gears meshing with each other; for instance, in the case of milling spur gears, the cutter and gear rotate according to the ratio of the number of starts of the cutter to the number of teeth. The cutting edges of the milling hob are machined in such a manner as to produce a smooth surface.

Presuming a properly operating dividing head to be used, the precise form of the tooth produced depends upon the exact form of the milling hob or cutter which must run true and be mounted on the mandrel without clearance. In order to cut teeth with the aid of the cutter so as to meet particularly exacting requirements, the dimensions of the tooth profile, of the pitch of the gear teeth and that of the grooves must correspond as accurately as possible to the calculated value. All cutting teeth must lie exactly on a helical line. Of particular importance is the flank and the smooth surface finish of the individual teeth of the milling cutter. To obtain smooth flanks of tooth during the milling operation the face and the flanks of the cutter must be smooth and free of scratches.

To fulfil these conditions as far as possible the cutters are nowadays manufactured as relief ground cutters in the following manner:

The cutter body is first formed on a turning lathe, furnishing a tubular cylindrical or disklike body with a central bore. Grooves are then milled or cut in the cutter body, which extend in parallel with the axis thereof, leaving material intermediate these grooves for forming the teeth. The flanks of the teeth are formed next by relief cutting or grinding of the individual teeth. A heat treatment is then applied in order to remove stresses in the material, followed by tempering or hardening. As the next operation, the bore of the cutter is ground and lapped, followed by a sharpening of the face of each tooth. In the case of cutters with ground faces the relief grinding is the last operation. It is carried out on special machines, with the aid of double-coned-, hollow conical-, or conical end grinding wheels.

These grinding wheels are small in size and are liable to be damaged, particularly when manufacturing cutters having a small pitch. They must permit a relief grinding of the individual teeth of the cutter without damaging the next following tooth as this occurs when using larger grinding wheels. The manufacture of these small grinding wheels is expensive, and they are subjected to considerable wear. They are, however, indispensable in the present-day manufacture of high-grade milling hobs. A further disadvantage of the relief ground cutter consists in the fact that during the grinding operation the roughness of the surface of the finish ground teeth of the cutters cannot be removed. The method of fine polishing hardened tools consists in treating the latter with moistened polishing materials, that is to say, in lapping which is employed for the face of the tooth but which could not hitherto be employed for the flanks thereof.

The manufacture of such milling hobs or cutters as practiced in the past thus requires operations which consume considerable time and labor, and necessitate the use of expensive special handling and special tooling equipment. The new method eliminates many of the obvious drawbacks and disadvantages. It contemplates the following steps:

1. The provision of a concentric composite ring structure comprising a ring made of a soft metal, copper or soft iron, for instance, and another ring made of a hard metal, e. g., tool steel attached to the first mentioned ring by welding or soldering or the like. The first mentioned ring of soft metal may be termed the "carrier member" or "carrier ring," and the other ring may be designated as "tool ring".

2. A polygonal member which may be termed the "base member" is driven or pressed into concentric engagement with the carrier ring noted

above, forming with the composite rings a uniform, accurately centered structure.

3. This structure is put on a spindle or mandrel, or on another suitable tool, and the profile and flanks of the cutting teeth are cut or ground from and into the material of the tool ring which is made of hard metal.

4. Axial grooves, which may be termed "tension grooves," are then cut or ground into the tool ring to a depth reaching the carrier ring, thus producing on the soft carrier ring individual axially or longitudinally extending teeth of hard metal.

5. The profile of the individual teeth segments may then be treated by lapping or the like, to produce a smooth crack-free surface.

6. The resulting structure is put into a suitable device, for example, in a press or die, and wedges or wedge-like members are driven into the tension grooves, exerting a radial pressure for the purpose of deforming the carrier ring radially, that is, pressing the soft material of the carrier ring into the spaces on the polygonal member. This step disposes the individual teeth at an angle determined by the form of the polygon and secures the carrier ring in firm interlocking engagement with the polygon.

7. Finishing operations, such as sharpening, and finally, lapping and smoothing the individual teeth of the tool, may be applied if desired or necessary.

The invention will be better understood from a detailed description rendered below with reference to the drawing. In this drawing,

Fig. 1 shows a section through the initial composite ring structure comprising, in this embodiment, a centrally disposed polygonal member, an inner carrier ring disposed on the polygon, and an outer tool ring of hardenable metal attached to the carrier;

Fig. 2 is a section through the structure shown in Fig. 1, along the line 2—2, also indicating the step of providing the proper profile and the flanks for the cutting teeth of the tool;

Figs. 3 and 4 represent sections through a device for performing the step of pressing sections of the soft carrier ring into corresponding depressed spaces on the centrally disposed polygonal member; and

Fig. 5 is a partial section through the finished tool.

Referring now to the drawing, showing one embodiment of the invention, numeral 1 indicates the ring made of tool steel or hardenable metal. Within this ring is disposed the carrier ring 2 which may be made of copper or soft iron. These rings are joined by hard solder or by welding or the like. The tool ring 1 is suitably tempered or hardened. This constitutes the first step in the process of producing the tool, resulting in a concentric composite double ring, the outside ring 1 of which is hard and the inside or carrier ring 2 of which is made of soft material.

The boring 10 of the copper ring (carrier ring) is suitably machined, for example, on a turning lathe, so as to provide the proper inside diameter. A polygonal member 3, shown in Figs. 1 and 2 in plan view and in section, respectively, is driven or pressed into position within the boring 10 of the carrier ring 3 so as to assume the central centered position shown. The body then resulting, in this embodiment, comprises the following parts, listing these parts from the inside to the outside: 1—a steel polygon having a central boring; 2—a soft carrier ring made of copper or soft iron or the like; and 3—a hard outer ring of tempered or hardened tool steel or similar suitable material.

This body is placed on a suitable spindle or mandrel for the purpose of grinding on the outer tool ring the required lateral surfaces 11 and the sides or flanks 12 (Fig. 2) of the profile of the tool. Grinding wheels having relatively large diameters, that is, for example, fast rotating grinding wheels, may readily be used for performing the required operation since a relief grinding is not effected. Such grinding wheels are relatively cheap, and the grinding is carried out with the desired accuracy even in the case of profiles with the smallest module. The resulting surfaces of the profile are accurately centered with respect to the central boring of the tool.

If very smooth surfaces are desired in the tool structures to be produced, for example, if the tool is intended for the manufacture of small gear wheels for precision apparatus, the surfaces may be polished by lapping so as to produce the required surface finish. It may be stated that the smoothness of the surfaces which can be produced according to the present method could not be obtained even approximately by employing previously known processes.

The next step has to do with forming the individual teeth in the cutter. Axial grooves 13 are cut or ground for this purpose in the outer steel or tool ring 1, to form individual hard segments forming the teeth 14 which are thus carried by and disposed on the soft carrier ring 2. The grinding of these grooves is carried radially down to the supporting carrier ring 2 at places corresponding to and radially substantially in line with or near the deepest points of the depressions formed on the periphery of the polygon 3.

If desired, the individual teeth segments may be treated, for example, by lapping, so as to remove all cracks or surface grooves or blemishes. The teeth segments may thus be made microscopically smooth.

The resulting body is then placed into a device designed for exerting radial pressure on the soft carrier ring in the places determined by the tension grooves 13 so as to press the ring radially into engagement with the corresponding depressions in the polygon 3. This operation completes the process except for finishing steps that may be applied, and pitches the teeth radially at an angle as indicated at 7 in Fig. 5.

The device, in the embodiment shown in the drawing, comprises a ring 4 which is gradually drawn in axial direction into a ring 5, for example, by means of a screw spindle or by any other suitable means that may include a sturdy press. Wedges 6 project radially inwardly from the ring 4, as shown in Fig. 3, or are disposed as shown in this figure. These wedges are driven within the tension grooves 13 radially against the soft carrier ring 2, and thus deform and press the ring at the indicated points into the peripheral depressions on the polygon 3.

The form of the soft carrier ring after this operation and the resulting form and angle of the teeth 14 is apparent from Fig. 5. The material easily withstands the deformation and the proper angle of relief may thus be obtained with an accuracy and certainty that was unobtainable in the past. The teeth of the tool are

by this operation also firmly interlocked with the centrally disposed polygon.

The face of the teeth may now be sharpened and finally lapped, and the tool is ready for use.

Time may be saved in the process of producing this novel tool by certain preparatory steps or refinements that may be easily carried out. For example, the profile or tool ring may be milled or lathed before being attached to the support or carrier ring 2, and then properly hardened, as described before.

The device shown in Figs. 3 and 4 for effecting the steps of pressing the soft carrier ring 2 into interlocking engagement with the polygon, and thus for pitching the teeth at the proper angle, may be constructed differently according to the particular tool which is to be produced, or for any other considerations, so long as the intended object is achieved.

The new method presents the following great advantages:

The time required in carrying out the different operations involved in the production of tools including milling hobs and form cutters is considerably reduced. The time necessary for grinding the profile amounts in the new method to a few minutes as compared to the several hours required in relief grinding formerly necessary.

The surfaces of the flanks of the cutter teeth and therefore also the surfaces of the toothed wheels or profiles produced are considerably smoother than the surfaces of the teeth which can be cut with the best known ground cutters.

The number of teeth of the cutters may be increased approximately by 25%, so that a particularly smooth surface of the flanks of the teeth may be obtained which is above all very important when cutting a small number of teeth.

Also cutters with the smallest module, for instance, 0.1, may be ground. The teeth produced with the aid of these small cutters present a very smooth surface finish, as may be detected by the microscopic method and careful measurements with the gears in operation.

The cost of a cutter manufactured according to the present method is 50% lower than that of a cutter with relief ground flanks. This considerable reduction in cost is due to the saving in expensive high-grade tool steels as well as to the considerably shorter time required in the manufacture of the cutters.

The new method may, of course, be carried out in different ways to meet particular requirements. The cutters thus produced may be employed for all kinds of gearing and profiling work. Spur- and spiral gears and profiles of any shape may be manufactured with such accuracy as to insure a complete interchangeability of the toothed bodies produced. The greater number of teeth of the cutter permits a greater feed as well as higher cutting speeds and therefore an increase in output while at the same time improving the smooth surface finish of the teeth produced. The method, as initially remarked, may also be employed in the manufacture of taps and cutting dies.

FRIEDRICH WENZEL.

PUBLISHED

JUNE 1, 1943.

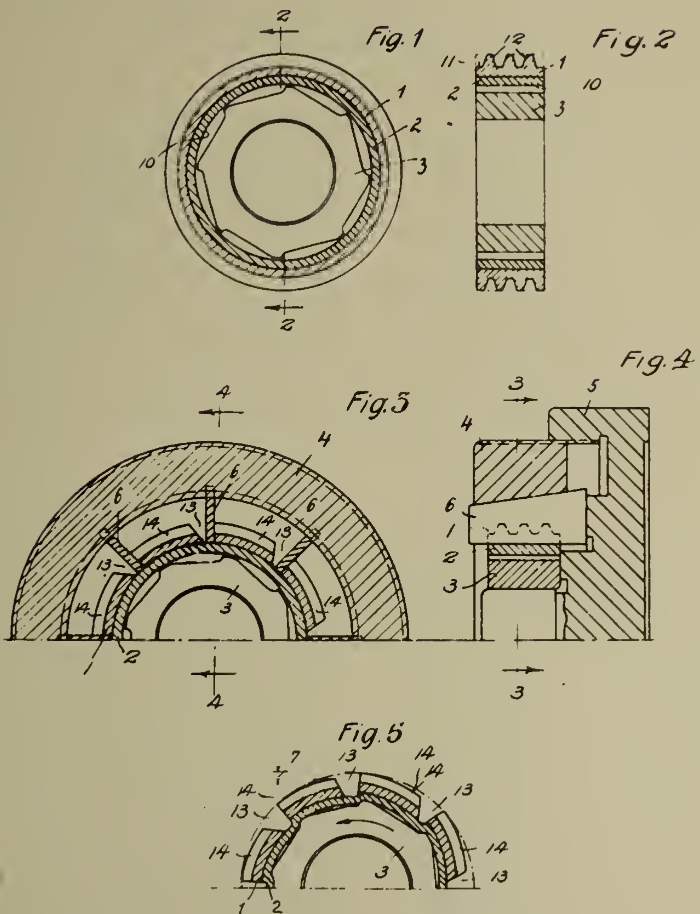
BY A. P. C.

F. WENZEL

METHOD OF PRODUCING TOOLS

Original Filed Sept. 8, 1939

Serial No. 406,948



Inventor
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By Richardson and Geier
Attys

Published June 1, 1943

Serial No. 402,042

ALIEN PROPERTY CUSTODIAN

DEVICE FOR CUTTING THREADS SIDEWISE WITH AUTOMATICALLY WITHDRAWING TOOL

Francesco Malagrino, Torino, Italy; vested in the Alien Property Custodian

Application filed July 11, 1941

This invention has for its object a device which allows the ready and rational cutting of either quadrangular or triangular threads on the lathes. By said device the forming of quadrangular threads is improved by the fact that the tool is rapidly and automatically withdrawn from the piece of work after the cut, while, as it regards the triangular threads, the improvement is obtained by the fact that the tool works only on one side of the thread so that a greater quantity of material may be detached at each cut without peril of tool chatterings, the wrenching of the threads being thus avoided and the working speed being remarkably increased.

The device according to the present invention substantially consists in a turret comprising a base plate fixed to the lathe carriage and a prismatic block slidable on said plate in a direction oblique to the axis of the carriage feeding, for instance in a direction forming an angle of 60° with said axis. Said block is driven by means of a micrometric screw pivotally mounted in a little bracket of the base plate and it is guided by guide means adapted and arranged to assure its movement in the established direction.

The tool carrier unit is adjustably fixed to a side of the block or moving part of the turret so that it participates to this diagonal movement of said block to cause the tool to penetrate into the work piece for an identical depth by the several cuts. Said carrier unit comprises a supporting piece fixed to the block and the tool carrier proper, which is able to longitudinally slide in a dovetail slot of the supporting piece. A spring disposed between both these parts tends to cause the tool carrier to return, the latter being maintained in the working position by means of a clamping tooth apt to be brought into disengaging position by hand or by means of a stop or the like, with which a tappet device cooperates after the cut in such a manner that the tool is caused to snap in withdrawn position by freeing itself from the piece of work.

A form of execution of the device according to the invention is illustrated, only by way of example, on the accompanying drawing, in which:

Fig. 1 is a plan view of said device;

Fig. 2 is a section of the same through line II—II of Fig. 1;

Fig. 3 is a section of said line through the broken line III—III of Fig. 2;

Fig. 4 is a section through line IV—IV of Fig. 1, and

Fig. 5 is a partly sectioned side view of the tool carrier.

With reference to the drawing, with 1 is indicated a base plate having at one end a flange 2 and provided on the upper surface with wide and not much deep diagonal slots 3 in which engage corresponding ribs formed on the under face of a block 4 apt to slide in diagonal direction on the base plate. This block is also guided by a sleeve 5 with vertical axis, which is fixed to the base plate, passes through a diagonal opening 6 of the block and presents at the top a lateral flange portion 7 fixed on the upper border of the flange 2 by means of screws. The base plate 1 and the flange portion form thus a box within which slides the block 4 forming an adjustable turret designed to be mounted upon a horizontal lathe by means of a screw bolt passing through the sleeve 5.

The diagonal movement of the block or turret 4 is actuated by means of a micrometric screw 8 screwed in a vertical face of the turret and mounted pivotally but without possibility of axially moving in a supporting piece carried by the flange 2. Said screw is provided with a head having a handwheel 9, which carries a scale 10 moving in front of a fixed index. A clamping screw 11 serves to fix the turret when the lathe is not used for thread cutting.

The pitch of the micrometric screw is so chosen as to enable the operator to directly read on the scale 10 the substantial penetration at 90° of the tool 27 into the piece of work, that is to say said pitch is proportional to the trigonometrical functions of an equilateral triangle. For instance, by a pitch of mm 1,15475 and a scale divided in 100 parts, if the handwheel 9 is caused to accomplish one revolution, the tool advances on the side of the thread for mm 1,16, but the thread depth perpendicularly to the axis of the piece of work is exactly of 1 mm.

The other three vertical faces of the block 4 are wholly uncovered, and the tool carrier may be mounted on same. To this end each of said faces presents slots with inclined side guide wands 12 and a wide central vertical rib 13 having a deep hollow within which a T-key 14 is slidably mounted, the movement of said key being obtained by means of a bolt 15 having an eccentric portion 16 which engages in a hole of the key. The tool carrier unit has side projecting parts 17 with inclined faces and a central T-slot 18 which may respectively brought in engagement relation with the inclined wands 12 and the key 14, said tool carrier being able to be clamped in a regulated position by turning the bolt 15 in such a manner as to push by its eccentric portion 16

the key inwardly and therefor the side projecting parts of the tool carrier unit against the inclined wands 12 of the turret.

The exact centering of the tool carrier unit is obtained by means of a screw 19 screwed in said unit and having at its upper portion a collar 20 engaging in a slot 21 formed in an eccentric collar 22 of the bolt 15. The screw 19 is hollow in its threaded portion and it is made expansible by means of longitudinal cuts. In said screw is disposed a pin movable axially, which has a conical head 23 engaging in a corresponding widening of the under hole end of the screw 19, an eccentric lever 24 being mounted on the upper end of said pin. When said lever is brought in horizontal position, it frees the expansible portion of the screw, which may be caused to rotate in order to vertically move the tool carrier unit with respect to the turret, while when said lever is brought in vertical position, it causes the screw to expand in such a manner as to be clamped in its seat, the tool carrier unit being thus fixed in a regulated position. To regulate this unit it is first rotated the screw, the toothed collar 20 of which, engaging in the slot 21, prevents the axial screw movement by obliging the unit to vertically displace itself; when said unit has rejoined the regulated position, it is clamped in the same by means of the bolt 15.

The tool carrier unit comprises a little block 25 fixed to the turret in the above described manner and having on its external face a longitudinal dovetail slot within which the tool carrier proper 26 may axially slide, the tool 27 being mounted in said carrier in the usual manner by means of the setting screws 28.

The tool carrier 26 is subjected to the action of a spring 29, which tends to bring and maintain it in a withdrawn position, said carrier being able to be pushed outside in working position by means of a cam lever 30 pivotally mounted at 31 on the little block 25 and having a notch 32 in which may engage an elastic tooth 33 designed to maintain the tool carrier in working position.

The elastic tooth 33 may be actuated by means of the lever 34 for freeing the cam lever 30 and thus allowing the tool carrier to be brought in inactive position by the action of the spring 29. Furthermore said tooth may be chamfered according to a suitable angle in order to gradually detach the tool from the bottom of the thread of the piece of work.

The lever 34 may be actuated either by hand or by means of the fine toothed button 35 or automatically by means of a tappet 36 apt to cooperate at the end of each cut with a stop fixed to the lathe, to the end of removing the tool from the work piece and bringing again the turret into the initial position.

The form and the particulars of construction of the device may, of course, vary in any whatever manner according to the exigences of the practical employ without coming out from the frame of the present invention.

FRANCESCO MALAGRINO.

PUBLISHED
JUNE 1, 1943.

F. MALAGRINO
DEVICE FOR CUTTING THREADS SIDEWISE WITH
AUTOMATICALLY WITHDRAWING TOOL
Filed July 11, 1941

Serial No.
402,042
2 Sheets-Sheet 1

Fig. 1.

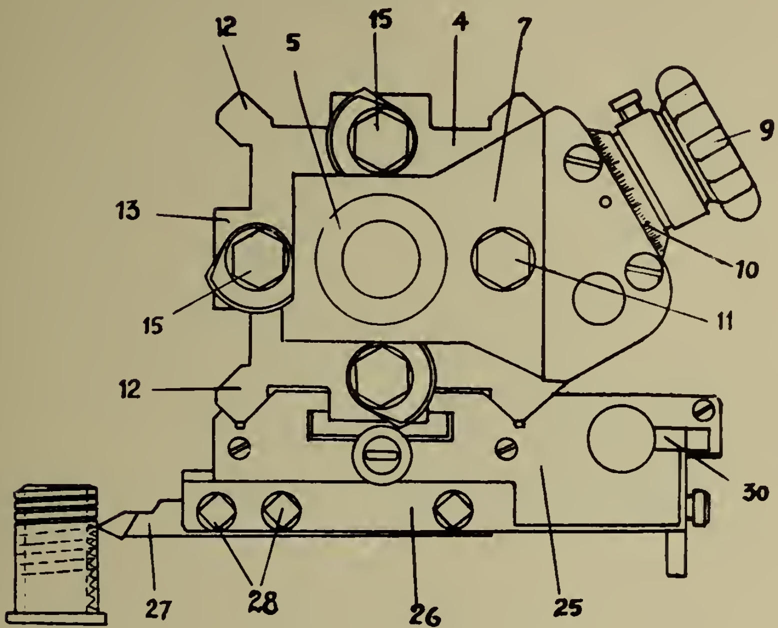
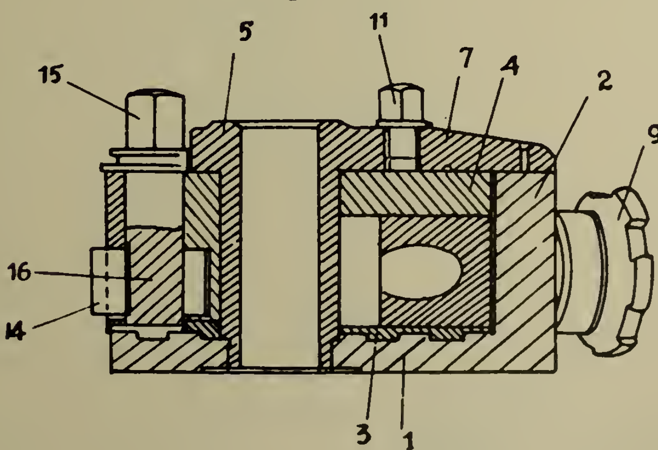


Fig. 2.



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F. MALAGRINO

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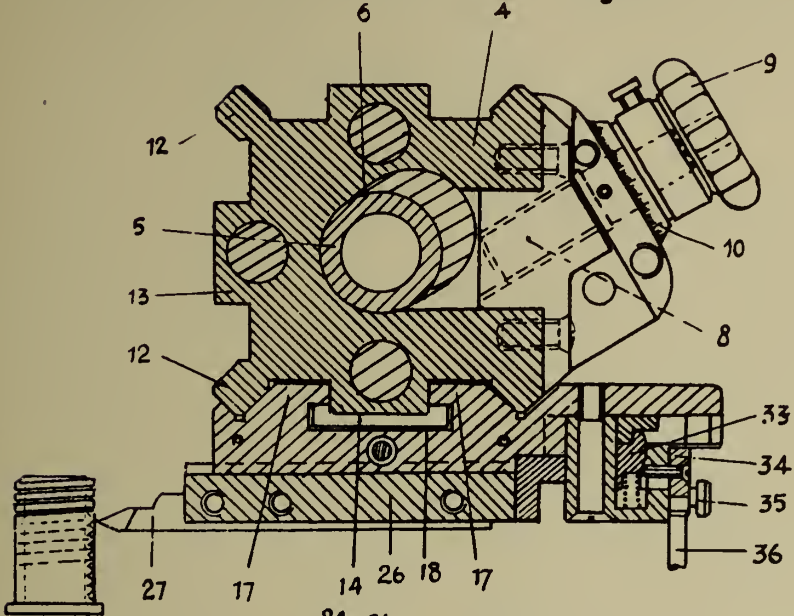
402,042

2 Sheets-Sheet 2

Fig. 3.



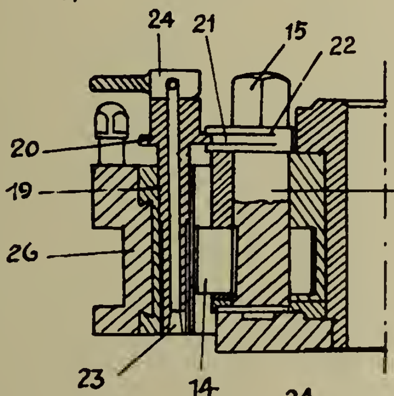
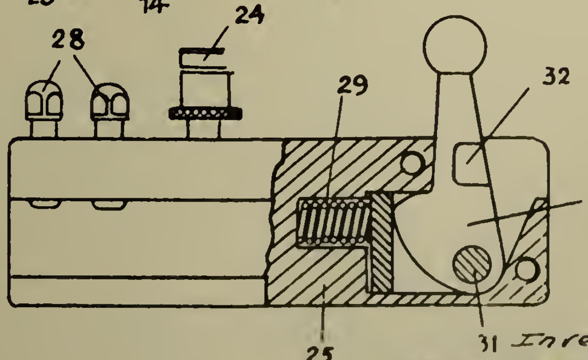


Fig 4.

Fig. 5.



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By: Stevens and Davis
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Published June 1, 1943 Serial No. 407,518

ALIEN PROPERTY CUSTODIAN

CUTTER HEAD FOR MILLING MACHINES

Karl Jansen, Mannheim, Germany; vested in the Alien Property Custodian

Application filed August 20, 1941

The present invention relates to a cutter head for milling machines, said head being provided at the circumference thereof with a plurality of cutters for milling plane surfaces, for example the surfaces of machine casings.

Hitherto surfaces of the type described were worked with a planing machine in a preliminary planing off operation and a following planishing operation. Milling machines were also used having cutter heads with a plurality of cutters disposed on the circumference thereof. Smooth surfaces with the required tolerance can only be produced in this manner if the cutting edges of the cutters move without any shocks. Even minute shocks or vibrations cause corresponding uneven portions of the surface. It is very difficult to assure shock- or vibration-free operation particularly of larger cutter heads. A basic condition for vibration-free operation is utmost care in grinding the cutters. In actual practice vibration free milling can very seldom be found. Advance of the cutter must be held within very small limits and the cutters must be operated at very high speeds so that the surfaces milled at different revolutions of the cutter head are superimposed. Such small advances do not meet present day requirements as to operating speed and size of machines.

Combinations of milling and planing machines have been proposed whereby preliminary planing off is accomplished by the cutter head of the milling machine during movement of the work piece in one direction and planishing is carried out while the work piece moves in the opposite direction. This method is composed of two operating steps and is therefore complicated and it also includes the undesired planing operation. Milling machines having a plurality of spindles and cutter heads operating in series have been proposed whereby the planing off operation is done at slow speed, with small diameter cutter heads and planishing by larger diameter, high speed cutter heads. Such machines are also complicated and expensive.

It is an object of the present invention to provide a cutter head for a milling machine which avoids all the disadvantages set forth above. In the cutter head according to the present invention the cutting edge of one or of a plurality of the cutters disposed on the same cutter head for each surface portion to be worked is broader than that of the other cutters and protrudes in axial direction slightly further than the cutting edges of the other cutters. The broader cutter or cutters act as planing off cutters. The broader cutting edges are preferably of such size and in such position that the planed off surfaces overlap after each revolution of the cutter head. It is important that the cutting edge of only one or of a plurality of the cutters is broader than that of other cutters. If the edges of all cutters would be made broader rattling of the cutter head and the milling machine would be unavoidable at the high pressures at which the milling operation takes place. A milling machine provided with cutter heads according to the present invention has only one cutter head for each surface to be milled and may be operated at the same advances which can be used in conventional milling machines only if a plurality of cutter heads are provided for each surface portion to be milled or if an additional planing machine is provided. With the machine according to the present invention the desired surface quality can be produced in one operating step. Of course increased smoothness of the surface may be obtained by milling the surface twice. In the latter case much larger advances such as 12 inches per minute and more may be employed.

Further and other objects of the present invention will be hereinafter set forth in the accompanying specification and claims and shown in the drawings which, by way of illustration, show what I now consider to be preferred embodiments of my invention.

In the drawings:

Figure 1 is a bottom view of a cutter head according to the invention.

Figure 2 is an axial sectional view of a cutter head according to the invention.

Like parts are designated with like numerals in both figures of the drawing.

Referring more particularly to the drawing, the cutter head **1** is carried by the rotating spindle **2**. Head **1** is provided with recesses or notches at its circumference into which the cutters **3** and **6** of which only some are shown in the drawings are inserted. The cutters **3** are provided with cutting plates **4** made in conventional manner of high quality cutting steel which form small cutting edges **5**. One or more cutters **6** are provided with a cutting edge **7** which is broader than that of the cutters **3** and which slightly protrudes in axial direction beyond that of the cutters **3**.

While I believe the above described embodiments of my invention to be preferred embodiments, I wish it to be understood that I do not desire to be limited to the exact details of design and construction shown and described, for obvious modifications will occur to a person skilled in the art.

KARL JANSEN.

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K. JANSEN

CUTTER HEAD FOR MILLING MACHINES

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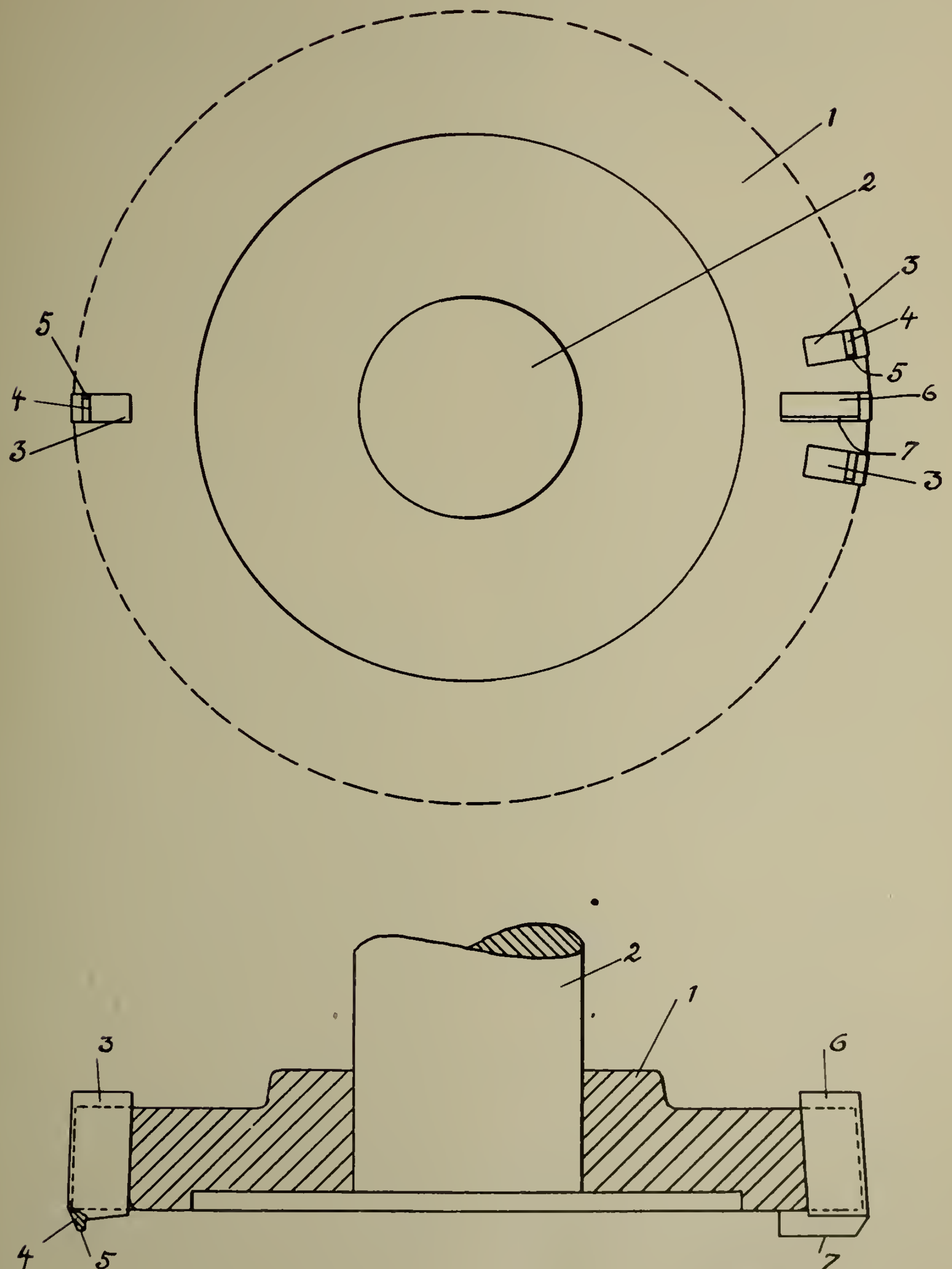

INVENTOR

BY Karl A. Mayr

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Published June 1, 1943

Serial No. 407,802

ALIEN PROPERTY CUSTODIAN

PAPER FILMS CONVEYOR

Ernst Zollinger, Turin, Italy; vested in the Alien Property Custodian

Application filed August 21, 1941

This invention relates to a device for conveying paper or films through the known automatic machines for development and other treatments of photographs. A construction of the object of this invention is shown diagrammatically and by way of example in the accompanying drawing, wherein:

Figure 1 is a vertical longitudinal section of the conveyor used in connection with an ordinary automatic machine for development and other treatments of photographs.

Figure 2 is a cross section thereof on a smaller scale,

Figures 3 and 4 show details.

As is well known, automatic machines for development and other treatments of light sensitive photographic material include a plurality of vertical tubs *a, b, c,* arranged beside one another and containing the various baths through which the light sensitive material is successively conveyed by conveyors of various constructions at suitable speeds and in which it undergoes the desired treatment.

According to this invention an individual conveyor is provided for each compartment or tub *a, b, c*; all the conveyors operate synchronously and means are provided between the individual compartments for transferring the material under treatment from one compartment to another. Each conveyor comprises an upper shaft **1**, which is in this case a driving shaft, carrying near its ends two pulleys **1'** or similar members; a lower shaft **2** carrying two pulleys **2'**. An endless flexible band **3**, supported beach driving pulley **1'** descends in a loop form towards the bottom of the tub over the transmission pulley **2'**. The conveyor further comprises two top shafts **4**, **5** situated on opposite sides of the middle plane of the compartment or tub and carrying in the planes of the pulleys **1' 2'** the pairs of supporting pulleys **4' 5'**; a lower shaft **6** carrying in the above mentioned planes two further pulleys **6'**. Each pair of supporting pulleys **4'**, **5'** cooperate with a further endless flexible band **7** descending towards the bottom of the tub in the form of two loops, one of which passes over the transmission pulley **6'**, while the other passes over the pulley **2'** and contacts with the band **3** on the pulley **2'** and on the two portions moving from this pulley up to the pulleys **4'**, **5'**.

The unit comprising the shafts **1**, **2** and **5** is supported by way of example by the uprights **8** (see Figs. 1, 2), while the shafts **4**, **5** may be supported by arms extending from the same uprights **8** or by independents supports **9** secured to the walls **10**. The contacting portions of the bands **3**, **7** travelling together on the transmission pulleys **2'** are kept stretched by stretching means **11** mounted for oscillation at **12** on the uprights **8** and pressed by spring means **13**. The portions of the bands **7** descending from the pulleys **4'**, **5'** down to the transmission pulleys **6'** may also be stretched by the weight of the pulley **6'** and their shaft **6** mounted for vertical displacement within slits **8'** in the uprights.

The shafts **1** are rotated all in the same direction as for instance, the direction shown by the arrows on Fig. 1, and at the same speed. The bands **3** carried by the pulleys **1'** are driven and as they rotate the transmission pulleys **2'**, they also carry along by friction the bands **7** and actuate the pulleys **4'**, **5'** and the transmission pulleys **6'**. If desired, the side pulleys **4'** and **5'** may also be operated as driving pulleys by providing on the shaft **1** a toothed wheel **1''** meshing with toothed wheels **4''**, **5''** of suitable diameter mounted on the shafts **4**, **5** as shown in the modification of Fig. 3. In this case the bands **7** are also positively operated instead of being indirectly driven by friction by the bands **3**.

The paper strip or film **14** to be treated is fitted by its longitudinal edges between the portions of the bands **3**, **7** extending in contact with each other and travelling together between the pulleys **4'**, **5'** and the pulley **2'**.

The paper or film strip held by its longitudinal edges only between the two bands **3**, **7** performing a concordant translational movement, is successively conveyed through the various compartments or vertical tubs *a, b, c,* in the following manner. The strip **14** is caught between the pulleys **1'** and **4'** at a point where the bands **3** having left the pulleys **1'** pass over the pulleys **4'**; the strip **14** is caught by its longitudinal edges between the two contacting portions of the bands **3** and **7** and is conveyed through the bath contained in the tub; the strip **14** is again released from the bands **3** and **7** at the point where the bands **3** again pass over the pulleys **7'** and the bands **7** on the pulleys **5'**; the strip then issues tangentially to the pulley **5'**, is guided by an inverted trough **15** arranged between two succeeding tubs and is again caught between the pulleys **1'** and **4'** of the next tub at a point where the bands **3** having left the pulleys **1'** pass on the pulleys **4'** and is caught again between the contacting portions of the bands **3** and **7**. The strip **14** passes in this manner through all the tubs.

The flexible bands **3**, **7** may be in the form of

a band or belt of any suitable material adapted to withstand the action of the various baths. The various guide and driving pulleys, or part of them, may be grooved pulleys. The flexible bands may also be replaced by sprockets, in which case the various pulleys may have teeth adapted to engage with the sprockets, like the teeth **2''** shown in Figure 4 on the pulley **2'**.

According to the modification shown in Figure 5, the conveyor n in the form of a band is formed laterally with rips or teeth n' inwardly bent for retaining the edge of the pulley p and engaging therewith. Moreover, the pulley may be formed on its periphery with pins or teeth p' adapted to engage in the hollows between the teeth n' of the band in order to positively drive same.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

ERNST ZOLLINGER.

PUBLISHED

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BY A. P. C.

E. ZOLLINGER

PAPER FILMS CONVEYOR

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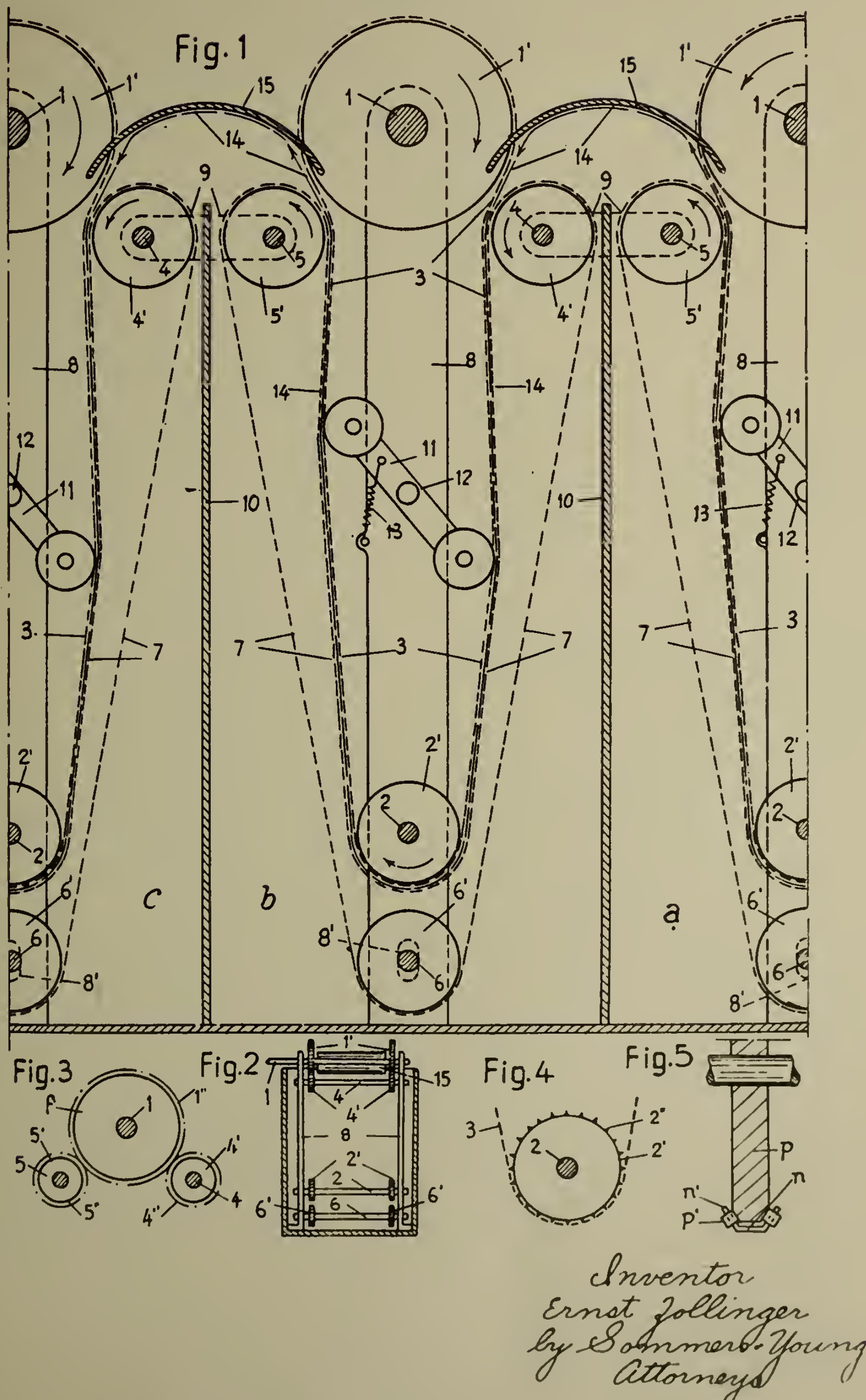

Published June 1, 1943

Serial No. 407,803

ALIEN PROPERTY CUSTODIAN

SUPPLYING WATER TO PHOTOGRAPHIC MACHINES

Ernst Zollinger, Turin, Italy; vested in the Alien Property Custodian

Application filed August 21, 1941

The consumption of water in automatic photographic machines which take photographs and deliver copies thereof in a few minutes, is considerable, as the water flowing in a continuous manner to the washing tubs is always in excess, and the constant supply at the rate required in the periods of maximum consumption when the machine works uninterruptedly is wasted when the machine is inoperative.

This invention relates to an automatic device for supplying an exactly regulated quantity of water for each photograph taken by the machine, the supply being automatically cut off in the intervals between the taking of two successive photographs.

It is an object of this invention to provide in the pipe supplying water to the washing tub an automatic valve which is closed by a spring and is opened and kept open during a constant predetermined time by an eccentric keyed on a shaft driven by the machine as it is in operation.

It is a further object of this invention to provide past the automatic valve a cock by means of which it is possible to exactly regulate the water flow through the automatic valve when the latter is open.

It is still a further object of this invention to provide on the cock a graduation and a pointer which can be moved to various positions corresponding to the various sizes of the photographs to be taken in order to regulate the water supply accordingly.

The accompanying drawing shows by way of example a construction of the object of this invention.

Figure 1 is a diagram of the water supply plant of an automatic photographic machine.

Figure 2 is a plan view of the eccentric actuating the automatic valve.

Figure 3 is a side view of the eccentric with the valve tappet acting thereon and opening the valve.

Figure 3 is a section of the cock situated past the automatic valve.

1 denotes a shaft connected to the driving mechanism of the photographic machine, which rotates only when the machine is in operation. The shaft 1 carries an eccentric 2 in the form of a disc having one or more notches in its periphery corresponding to inoperative positions of the machine.

In the example shown, the cuts are in the number of three and are denoted by $1'_1$, $1'_2$, $1'_3$. Arcuated sectors *e* extend between the cuts. The cuts are adapted to receive a roller 3′ of the tappet 3 lifting the valve 4; on each operating cycle of the machine the eccentric performs an angular rotation through 120° which is the distance between two successive notches. On angular displacement of the eccentric, the tappet opens the valve and keeps it lifted during the whole period of said displacement.

The valve 4 closes on a stem 4*a* under the action of a spring 5 which keeps it closed till it is lifted by the tappet 3. The valve 4 is interposed in the pipe 6 supplying water to the washing tubs (not shown) arranged in the collecting tub 7. A cock 9 is interposed in the pipe past the valve 4 and is operated by the handwheel 10 provided with a pointer 11 movable on the dial 12. The cock 9 may be opened by a greater or smaller extent in order to regulate the quantity of water supplied to the washing tubs during the opening period of the automatic valve 4.

In the diagram shown in Figure 1, the pipe extends from a constant level container 8, which is the water reservoir. A tube 13 is branched from the pipe 6 ahead the cock 9 and ends by a spray jet.

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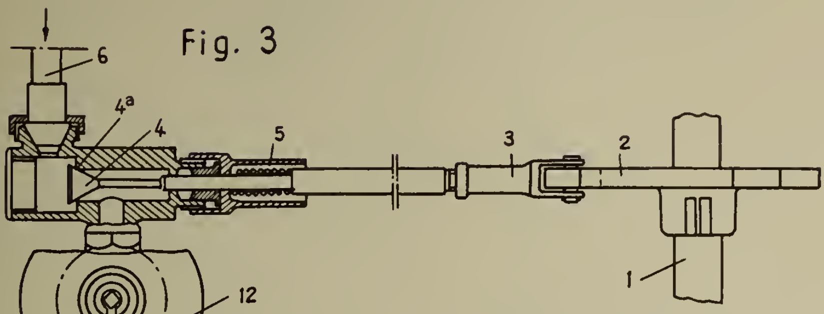
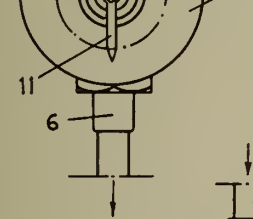
Fig. 3

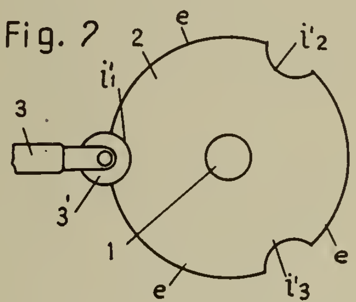
Fig. 2

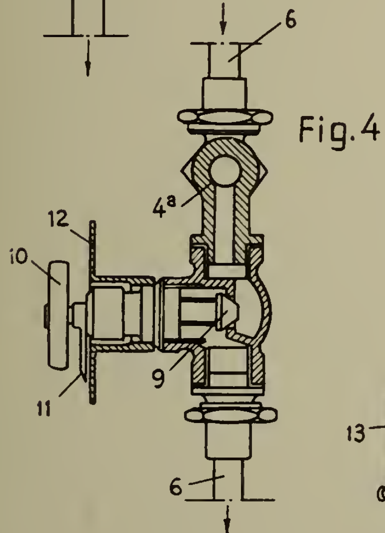
Fig. 4

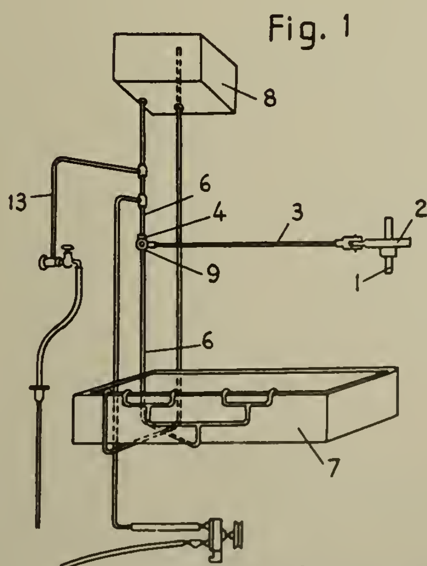
Fig. 1

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ALIEN PROPERTY CUSTODIAN

SHAPED BODIES AND PROCESS OF PREPARING THE SAME

Adolf Menger and Eugen Bock, Krefeld-Uerdingen, Germany; vested in the Alien Property Custodian

No Drawing. Application filed August 26, 1941

It is known that pressed plates may be prepared by mixing comminuted porous materials especially comminuted wood such as wood dust or shavings, furthermore leather, fibrous materials or the like with a liquid binding agent, if desired, while simultaneously adding a non-porous substance such as stone powder and, thereupon, pressing the mixture obtained, if desired, at a raised temperature.

This process of preparing pressed plates by using porous materials has the disadvantage that already during the mixing operation a considerable portion of the liquid binding agent penetrates into the interior of the particles of the comminuted material and, consequently, cannot take part in the binding process which during the pressing takes place at the surface of the said particles. In order to obtain plates of satisfactory strength it is, therefore, necessary to use such large quantities of liquid binding agent that the weight of the plates is for many purposes undesirably high.

The object of this invention is a process of preparing shaped bodies, in particular pressed plates, which avoids the above drawbacks. According to this new process the liquid binding agent is mixed in the form of foam with the porous material and the mixture is then pressed. It is surprising that the structure of the foam is not destroyed during the mixing with the comminuted material; the surface of the particles is coated rather with a layer of foam which lasts well and is hardly absorbed so that practically almost the entire binding agent is available for binding the particles of material when the masses are pressed together. Consequently this process requires quantities of binding agent which are much inferior to those used in the processes hitherto known and shaped bodies of much less weight are obtained.

In order to obtain shaped bodies of satisfactory strength it is necessary, according to the process of the present invention, to effect the pressing process at such temperatures and under such pressures that the foam structure of the binding agent is destroyed to a considerable extent. These conditions will easily be ascertained for each particular case by a simple test. The foam may be prepared according to any known manner by finely dispersing gases, especially air, in the liquid or dissolved glueing substance. It is advantageous to add foam-forming or foam-promoting agents such as, for instance, albuminous substances, saponins or the like or other natural or artificial organic compounds of high molecular weight. The gas may also be produced in known manner, in the solution of the glueing agent itself, for instance, by addition of carbonates or bicarbonates from which carbonic acid is then split off by heating or by adding an acid.

For the process of the present invention there are suitable binding agents of all kinds, especially synthetic binding agents, such as, for instance, those built up on the basis of condensation products from urea and aldehyde or from phenol and aldehyde, furthermore, natural binding agents such as glue from hides, bone glue, dextrin or the like.

According to the process of the present invention there may be obtained besides pressed plates, for instance, blocks, beams of any cross section, for instance, masts, T-girders or the like, chair legs, lamp stands, doorknobs, containers and casings or the like.

The following examples serve to illustrate the invention but they are not intended to limit it thereto; the parts are by weight.

Example 1

2,5 parts of butylnaphthalene sulfonic acid, 1 part of ammonium chloride, 5 parts of urea and 25 parts of an ammoniacal solution of casein of 5% strength are added to 100 parts of an aqueous solution of 65% strength of a condensation product from urea and formaldehyde. Into this mixture air is introduced in a finely divided state by means of a rapidly agitated stirring device until the volume of the glue-batch has trebled.

50 parts of this foamy glue mixture are well mixed with 1000 parts of wood shavings. The material thus obtained is brought into a press or a press mould and pressed for 12 hours at 20° C. whereby a pressed plate of remarkable strength is obtained.

Example 2

100 parts of a foamy glue mixture according to example 1 are well mixed with 1000 parts of comminuted wood waste obtained in the manufacture of ply wood. The material thus obtained is brought into a press or a press mould and pressed for 12 hours at 20° C. the structure of the foam being destroyed by the action of the pressure and the subsequent binding operation. In this way a beam of remarkable strength is obtained.

ADOLF MENGER.
EUGEN BOCK.

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ALIEN PROPERTY CUSTODIAN

CANAL LOCKS OF DRY-DOCKS AND OTHER BASINS

Jean Lipsky, Uzerche, France; vested in the Alien Property Custodian

Application filed August 29, 1941

The construction of a canal lock necessitates conditions of resistance very superior to normal ones, due to the fact that the top sides of the flood-gates have no bearing to resist the lateral pressure of the water.

The frame or truss-work of the flood-gate acting as a reenforcement at the top can, in no case, be equivalent, as a support, to that obtained on the other three sides by means of the cheeks of the lock bed and the two side walls of the lock. A top frame, having to comply with such conditions of resistance, even if made of special hard steels—assuming that this were possible—would always be so heavy that it would jeopardize the indispensable stability of a construction the mobility and the easy handling of which are essential characteristics of its operation.

Such an arrangement is even more difficult to realize when a sliding flood-gate is considered, the width of which is so much the greater that it can be made of only a single leaf. Sliding flood-gates are nevertheless preferable, if not necessary, for any maritime lock or dry-dock where the water pressures are exerted alternatively in one direction or the other, because, if arched gates were utilized, it would be necessary to dispose two sets of gates set in opposite directions, which condition, aside from the double cost involved, would also entail a rather considerable lengthening of the lock lift and a corresponding increase in the cost.

The difficulties encountered in the construction of a sliding flood gate as heavy as it is voluminous, the importance of the means utilized to operate it, and also the slowness in opening and in closing it as a result of both the weight of the mass to be moved and the distance to be covered throughout the entire opening or closing operation, are the main reasons why arched gates are generally used which gates offer the advantage of halving the mass to be moved, the operating means, and the distance to be covered. But arched gates are generally more expensive and have the disadvantage of lengthening the lock lift within certain limits.

Apart from the water supply problem, the achievement of locks for high water-falls and of large widths has always been impeded by difficulties of construction and operation inherent to the large sizes and weights of the down-stream gates, as well as by important conditions of different kinds which they must satisfy.

These constructions are all the more delicate as they are not rigidly fixed, and as the lateral pressures to which they are subjected do not enjoy a counteracting bearing surface rationally distributed, it being impossible to reenforce the top side of the said construction by means of fixed devices which would impede, after the opening of the gates, the passage of the ships.

On the other hand, once this construction has been achieved, its setting into motion always necessitates an important consumption of power as well as very expensive machinery, and the speed at which it moves is moreover very limited, which condition thus increases the operating time.

The problems which are thus set by the construction and displacement of large gates becomes more and more serious as the height of the water fall increases, and so it becomes necessary to have recourse to a series of double, triple or even quadruple locks to cope with important differences of water-level. Such a solution results in a considerable cost increase to which must automatically be added a lengthening of the time necessary for ships to pass through several locks instead of through a single one.

The main object of my invention is to reduce the weight of the gate itself and to allow its sectionizing lengthwise and along its width, thereby obtaining a saving in the weight of the gates, an easier handling, a greater operating speed, various other kinds of economies, and in certain cases, the saving of additional gates, and the possibility of replacing a series of locks by a single lock.

My invention consists in topping ordinary lock flood-gates, turning, sliding or other gates, with a mobile beam against which the top of the gate will be able to bear, just as the bottom of the gate rests against the lock-sill. This beam, constituting a bridge—which will hereafter be called "mobile beam bridge"—may be made to slide, to tip, to revolve or to rise.

Such an arrangement allows the closed door to be supported along its entire periphery. In those cases where the opening of the lock forms a rectangle, the width of which is much larger than the height, which is the general case, this arrangement allows the reenforcements to be laid out along the smallest length which goes from the lock-sill to the beam-bridge.

On the other hand, my invention permits of the horizontal and vertical sectionizing of the gates into separate panels which, thanks to their reduced size, will possess all of the advantages belonging to such constructions from the standpoint of ease of operation. This possibility of

sectionizing is particularly interesting whenever high water-fall locks are involved.

This flood-gate, mobile beam-bridge combination will obtain, among others, the following advantages:

1. Saving in the weight and consequently on the construction costs of the gate properly speaking as well as of the equipment, as a result of the support given to the top side. This saving may become, in common cases, equal to two fifths of the construction costs of ordinary gates and to about half of the total construction costs of the lock in those cases where this arrangement allows the substitution of a single, high waterfall lock for a series of smaller locks.

2. The reduction in the size and in the weight of the gates facilitates the construction thereof and gives them the best conditions of stability in the course of their operation.

3. The possibility of dividing into two leaves the sliding door which was constructed up to now in a single leaf, which offers a great facility and rapidity of operation and likewise a great facility of construction of the gates themselves and of their recesses in the masonry.

4. The light weight of the door and its relatively small volume will necessitate, for its operation, a smaller actuating power, with a consequent saving in operating costs.

5. The reduction in the time necessary for maneuvering the doors resulting from the speed of the operation consequent to the reduction in the weights and volumes to be set into motion. The operation of the gates and of the beam-bridge can, as a matter of fact, take place simultaneously or nearly to and, in the case of a gate comprising several superposed panels, it is possible to start filling up as soon as the lower part is set in place without wating for tne upper parts to be closed.

6. The possibility of replacing two-leaf revolving gates—exclusively constructed up to now as arched gates—by gates completely flat when closed, bearing at their base against a straight sill, and at their upper part against the mobile beam-bridge, which condition results in an increase in the useful space of the lock lift and in a reduction of the width of the leaves.

7. The suppression of the arched supplementary downstream doors facing opposite directions, which are constructed to allow the emptying of the lock lift or chamber which thereby becomes a sort of dry-dock generally used to repair the sidewalls, the bed, the aqueducts and sliding valves. For it is sufficient that the beam-bridge topping the single or double leaf sliding gate be provided with two flanges to allow the gate to resist upstream as well as downstream pressures.

For two leaf revolving gates, a special arrangement of a revolving or lifting mobile beam-bridge located at the base of the gate, opposite to, and up-stream with respect to, the lock-sill would allow to obtain the same result.

8. The two superposed panel gates with an intermediate mobile beam-bridge allows the construction of a single water fall lock in lieu of several low water fall locks and in this case, the new system permits to obtain much more important improvements.

By suppressing all but one of the locks, the number of mobile constructions, such as, upstream and downstream gates, safety devices, aqueducts, inlet and discharge valves, traction machines for the ships each one of which comprises a power generator, is reduced to the same extent. The chances of break-downs, of mechanical troubles or difficulties are also reduced at the same time and to the same extent and the degree of safety wherewith the lock may be operated is thereby increased.

Savings are also obtained with respect to the volumes of the masonry of the other lock-beds and even with respect to that of the side walls, especially where it is possible to use to advantage a rock bottom.

On the whole, it is possible to assert that a single lock replacing a series of three locks may permit to obtain a general saving of nearly one half of the total cost of the construction and of the equipment.

To the saving in time obtained as a result of the higher operating speed characteristic of lighter gates, must be added the saving corresponding to the time which would be necessary for the operation of the gates of the other locks, the said gates being now suppressed. In the case of a series of a three locks, this saving in time is of the order of 50%.

The following description and the appended drawing refer to various practical embodiments of my invention given by way of example not inclusive of all cases, it being well understood that the characteristics which appear as well in the drawings as in the text, constitute a part of my invention. It is particularly so, among others, of the arrangement devised to actuate the beam-bridges, whether they be of the tipping, sliding, revolving or lifting kind, applied, according to the case, to either revolving or sliding gates, single or double leaf, as well as to any other system of tipping or lifting gates.

Figure 1 is a plan view of a beam-bridge revolving together with a revolving two-leaf gate, for a single panel lock gate.

Figure 2 is a sectional view II—II of the gate of Fig. 1 along the axis of the lock lift, showing the position of the beam bridge.

Figure 3 is a plan view of a two-leaf sliding gate, resting on a tipping beam-bridge, for a single panel lock gate.

Figure 4 is a plan view of a revolving beam-bridge in conjunction with a single leaf sliding gate for a single panel lock.

Figure 5 is a front sectional view along line V—V of Fig. 7 of a double superposed panel gate comprising two tipping beam bridges operating in conjunction with two gates each of which is composed of a single leaf.

Figure 6 is a transverse sectional view of the gate along the axis of the lock lift (line VI—VI of Fig. 5) and shows, in elevation, the side wall of the lock and the hollow quoin and the tipping mechanism for the lower beam bridge.

Figure 7 is a similar sectional view VII—VII but showing in elevation, the side wall opposite to the preceding one, the hollow quoins for the gates and the tipping mechanism of the upper beam-bridge.

Figure 8 is a horizontal sectional plan view along line VIII—VIII of the upper sliding gate and of its hollow quoin.

Figure 9 is a horizontal sectional plan view along line IX—IX of the lower sliding gate and of its hollow quoin.

Figure 10 is a transverse sectional view of the lower beam-bridge showing one embodiment of said beam bridge.

Figure 11 is a detail view of point XI of Fig. 7.

Figure 12 is a front sectional view along line XII—XII of a multiple panel sliding gate, the

panels being superposed, for a high water-fall lock. The two upper panels are modeled to correspond to the profile of the ships only the rigging of which, of little width, needs free space at this height. The beam bridges are of the sliding type.

Figure 13 is a horizontal sectional plan view along line XIII—XIII of the uppermost sliding panel of the gate, and of the recess for the gate, showing the beam-bridge which supports the said panel, and the adjacent recess, as well as the fixed lateral shields between the panel and the lateral walls.

Figure 14 is a sectional view along line XIV—XIV of Fig. 15 in the axis of the lock lift, showing, in elevation, a side wall of the lock and the recesses for the gate panels.

Figure 15 is a front sectional view along line XV—XV of a high water fall, lock-well gate the opening of which in a downstream direction is effected by means of a tunnel. The gate is divided into two sliding panels by an intermediate beam-bridge, also of a sliding type.

Figure 16 is a vertical sectional view of the recess for the beam bridge along line XVI—XVI.

Figure 17 is a similar sectional view along line XVII—XVII of the hollow quoins for the two sliding panels of the gate.

In the embodiment shown in Figs. 1 and 2, the two leaves **1** and **2** mounted free to pivot on hinge-hooks, revolve, when the gate is closed, up against a beam bridge **3**, located immediately behind them, down-stream. The main supports for the two panels are the customary lock-sill **4** at the bottom and, at the top, the beam-bridge **3**. A tight fit is ensured, down-stream, by elastic joints or by any other means applied against the lock sill **4** on the one hand, and against the two side walls **5***a* and **5***b* on the other hand. A joint cover **6** can, combined with other means, stop up the chink between the two leaves.

The beam bridge may be withdrawn by tipping on a ratchet wheel, or as shown, by revolving about a vertical axis **7** sufficiently set back so as not to encroach on the recess **2***a* for the leaf situated on the same side, **1***a* being that of the opposite side. An arm with a counterweight **9** balances the weight of the beam-bridge.

When the gate is closed, two locks **10***a* and **10***b*, given by way of example, transmit the stresses of the beam bridge to the masonry of the side walls.

The operating of the three organs which make up the gate, the leaves and the beam bridge can occur, for the rapidity of the operation, simultaneously, or successively if necessary.

In the embodiment shown on Fig. 3, the lock gate comprises two sliding leaves **1** and **2**, the top part of which bear, when the gate is closed, against a tipping beam-bridge **3**. To open the door, the two leaves are made to retire into the corresponding recesses **1***a* and **2***b*. The beam-bridge and its counterweight **9** tip by rolling on the platform of the side wall, freeing themselves from the notches **3***b* and **3***c* into which fit the extremities of the beam when the gates are closed and the purpose of which is to transmit to the masonry of the side walls, either directly, or by means of locks as shown on Fig. 1, the stresses due to the pressure of the water on the leaves. Water tight conditions are ensured, not excluding other means, by a device similar to that of Fig. 1 and particularly by a joint cover **6** fastened onto one leaf and bearing on the other leaf, as a result of the pressure of the water, by means of a water-proof joint.

Figure 4 shows a single leaf sliding gate bearing on a revolving beam-bridge **3** and the recess **1***a* for the gate. The open position of the beam bridge is shown at **3***a*. Locks **10***a* and **10***b* are given by way of example and serve as lateral supports for the beam bridge when the latter is in a closed position.

Figures 5 to 11 show an example of a sliding gate, comprising two superposed panels, for a high waterfall lock. Numbers **11** and **13** designate the panels the respective heights of which are determined in consideration of the facility with which they can be constructed, the ease with which they can be handled, and the stresses which they will have to exert on the intermediary beam bridge.

The lower panel **11** is made to slide by means of rollers **11***a* upon which it is mounted, the said rollers running in a groove or guide **12** of the lock bed. The said panel is supported on each side by a sill **11***b* set against the wall of the groove. A floater chamber **14** of an appropriate size occupies the lower portion of panel **11**.

A tipping beam-bridge **15** has its tipping mechanism and its counterweight **16** placed in a recess cut out in the lateral wall opposite to the recesses **18** and **19** for the panels. Its plane of rotation coincides with the axial plane of the gate, so that the groove **20** formed by the flanges **20***a* of the lower part of this beam-bridge, symmetrically covers the top of the lower panel **11**. The latter thus finds a support on each side against water pressures acting in one direction or in the other.

Groove **21** formed by the flanges of the upper part of the beam-bridge constitutes a track way in which the upper panel **13** slides by means of rollers. The downstream flange of the U formed by this upper groove **21** serves as a lateral support for the base of the upper panel **13**.

The side faces of the beam bridge, at least in those parts where they bear against the masonry, may be slightly inclined so that they may smoothly fit into their bearings.

In order to laterally transmit the stresses in the door to the side walls and to ensure a good joint, the upper panel **13** is provided with crutch shaped organs **22** having the width of the flange of the lower beam bridge **15** and thus concealing the space between the panel and the downstream wall of the recess **17** for the beam bridge, the width of which is much greater than that of the gate. Another crutch shaped organ fulfills a similar function for the recess **19**, at the other extremity of the door, the panel having to enter deeply onto the said recess in order to allow the intermediate beam bridge to be lodged in it for closing purposes.

This latter panel **13** is topped by an upper beam-bridge **23** the tipping mechanism of which is situated on the side opposite to that of the lower beam-bridge **15**. This beam-bridge is made to tip on the platform of the side wall, above the masonry, against which, it finds lateral support, when in a closed position, by means of the two abutments **24** and **25**. The flanges at the lower part of the beam bridge form a groove **26**, acting as a guide, by means of which groove the stresses resulting from the pressure of the water on the panel **13** are transmitted to the beam-bridge.

Instead of having the panel topped by the beam-bridge as represented in the embodiment shown, the upper beam-bridge **23** may be located

downstream with respect to the gate and may bear on the side wall away from recess 17 for the lower beam bridge and recess 19 for the upper panel, by providing it with a lateral projection to make it adhere to the surface of the top of panel 13.

Water-proof conditions can be obtained, by elastic joints or by any other means, generally on the downstream side, and Figure 11 which shows point XI of Figure 7 in detail is an illustration, by way of example not inclusive of all means, of how continuous water-tight conditions may be ensured by means of packing 28 along the contact lines of the beam bridge 15, the panel 13, the crutch-shaped organ 22 and the side wall 27.

Figure 10 shows, by way of example, one embodiment of the intermediate beam bridge 15 the object of which is to avoid the torsion stresses to which it is subjected due to the fact that the water pressure on the lower panel is much higher than that on the upper panel. The lower panel 11 is offset in an upstream direction with respect to the vertical axis, whereas the upper panel 13 is offset in a downstream direction.

In the gate composed of two superposed panels, the lower panel may also be divided into two sliding leaves, and also two revolving leaves, but in this latter case, the closing of the gates and the closing of the beam-bridge can only take place successively.

In the embodiment described, the operations for closing the lock lift may take place in the following order:

1. Simultaneous setting in place of panel 11, or of the two leaves, and of beam-bridges 15 and 23.
2. Setting in place of panel 13 guided by the two beam-bridges 4. The order of the operations is reversed for opening the lock-lift.

Figures 12 and 13 relate to a multiple panel gate for a high water-fall lock.

The lower panel 11 retires into the recess 18 by sliding on the lock bed while the intermediary sliding beam-bridge 15 which caps this lower panel when shut, can retire into the recess 17 by sliding on the said panel. The upper panel 13*a* rolls on this intermediary beam-bridge 15 and can withdraw, to allow the opening of the gate, into a recess 19*a*. This upper panel 13*a* is capped by the upper beam-bridge 23 which slides, when the gate is to be opened, behind a shield 29, into a position of rest shown at 30. Symmetrically to shield 29, with respect to the axis of the gate, a second shield 31 is to be found, and the profiles of these two shields 29, 31 are designed in accordance with the profile of ships, so that the space, at the top, which exists between these two shields is smaller than that at the bottom, thus corresponding to the little width of the masts and other projecting apparatus on the decks of ships. This allows to construct the upper leaf 13*a* of the gate narrower than the lower leaf. The shields 29, 31 which, on the drawing, are supported by metallic trusses 29*a*, 31*a*, fixed onto the side walls, can be constructed in reenforced concrete or in any other material capable of resisting the pressure of the water.

Figures 14, 15 and 16 represent an embodiment similar to the preceding one but applied to a well-lock or tunnel-lock. The lock, which is situated at the entrance of the tunnel 32 comprises two sliding panels 11 and 13, separated one from the other by the intermediary beam-bridge 15. To open the lock, panel 13 is made to retire, by sliding on the beam-bridge, into a recess 19; then the beam-bridge 15 retires into the recess 17 by rolling on the lower panel 11, and finally, the lower panel 11 withdraws into the recess 18 by rolling on the lock bed.

The lower panel 11 is provided with rollers 11*a* rolling in a groove 12 of the lock bed. The beam-bridge 15 is provided with rollers 15*a* rolling on the lower panel 11 and it comprises flanges 20*a* which enchase the upper portion of this panel. Finally the upper panel 13 is provided with rollers 13*a* rolling in the upper groove of the beam-bridge. The top part of this panel 13 is supported, to resist the pressure of the water, by a flange 33 which is an integral part of the tunnel masonry.

JEAN LIPSKY.

PUBLISHED JUNE 1, 1943. BY A. P. C.

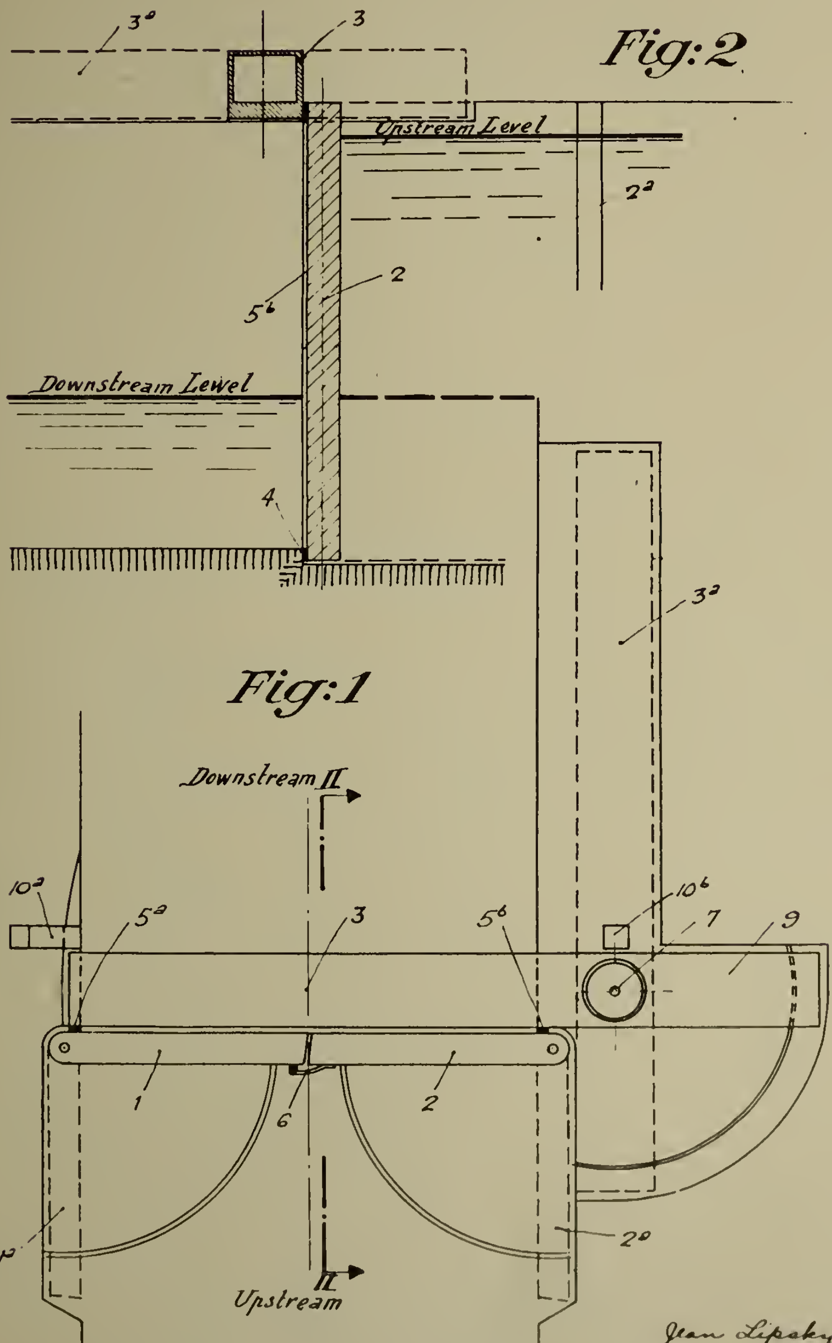
J. LIPSKY

CANAL LOCKS OF DRY-DOCKS AND OTHER BASINS

Filed Aug. 29, 1941

Serial No. 408,902

7 Sheets-Sheet 1



Jean Lipsky

By Watson, Cole, Grindle & Watson
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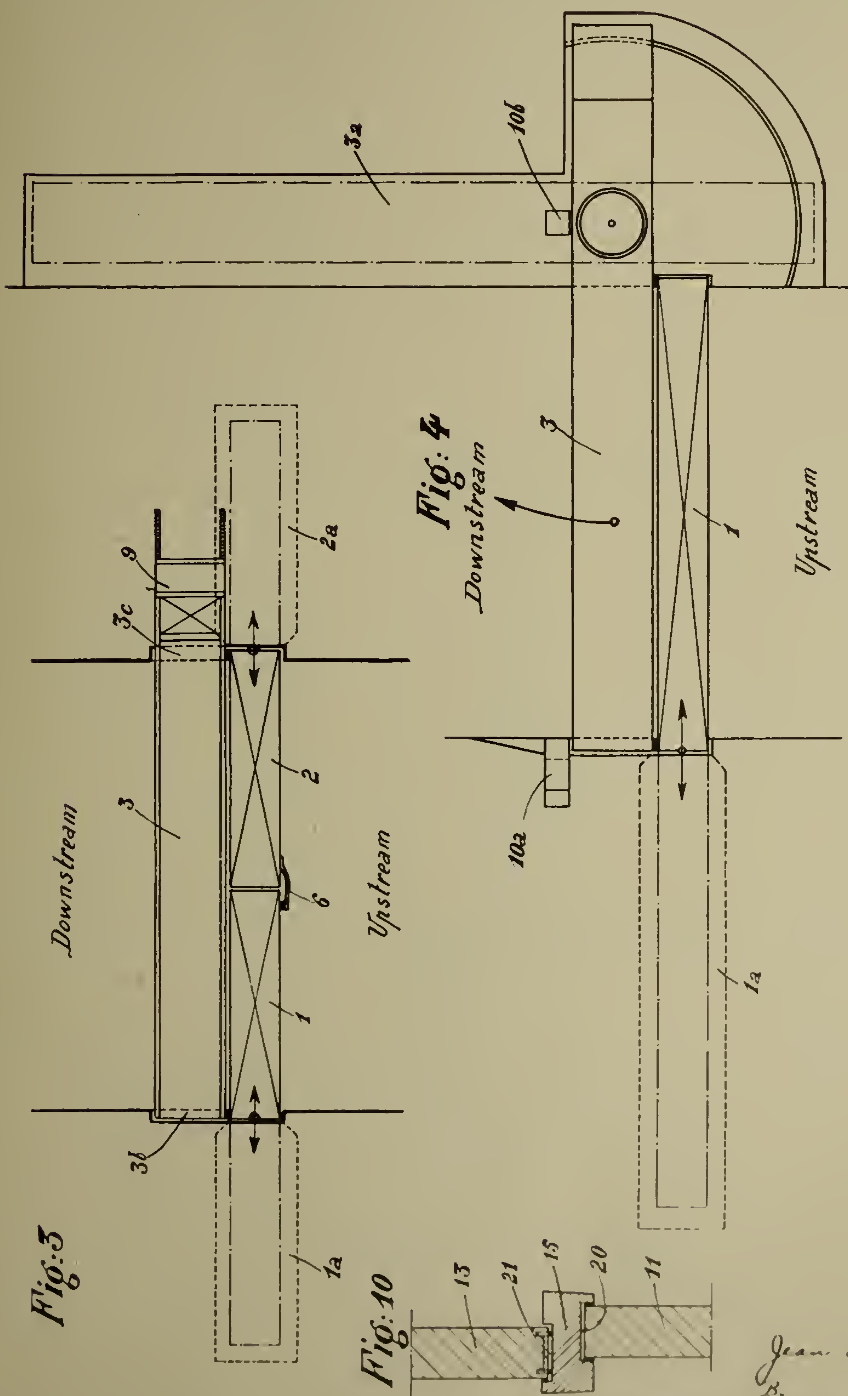

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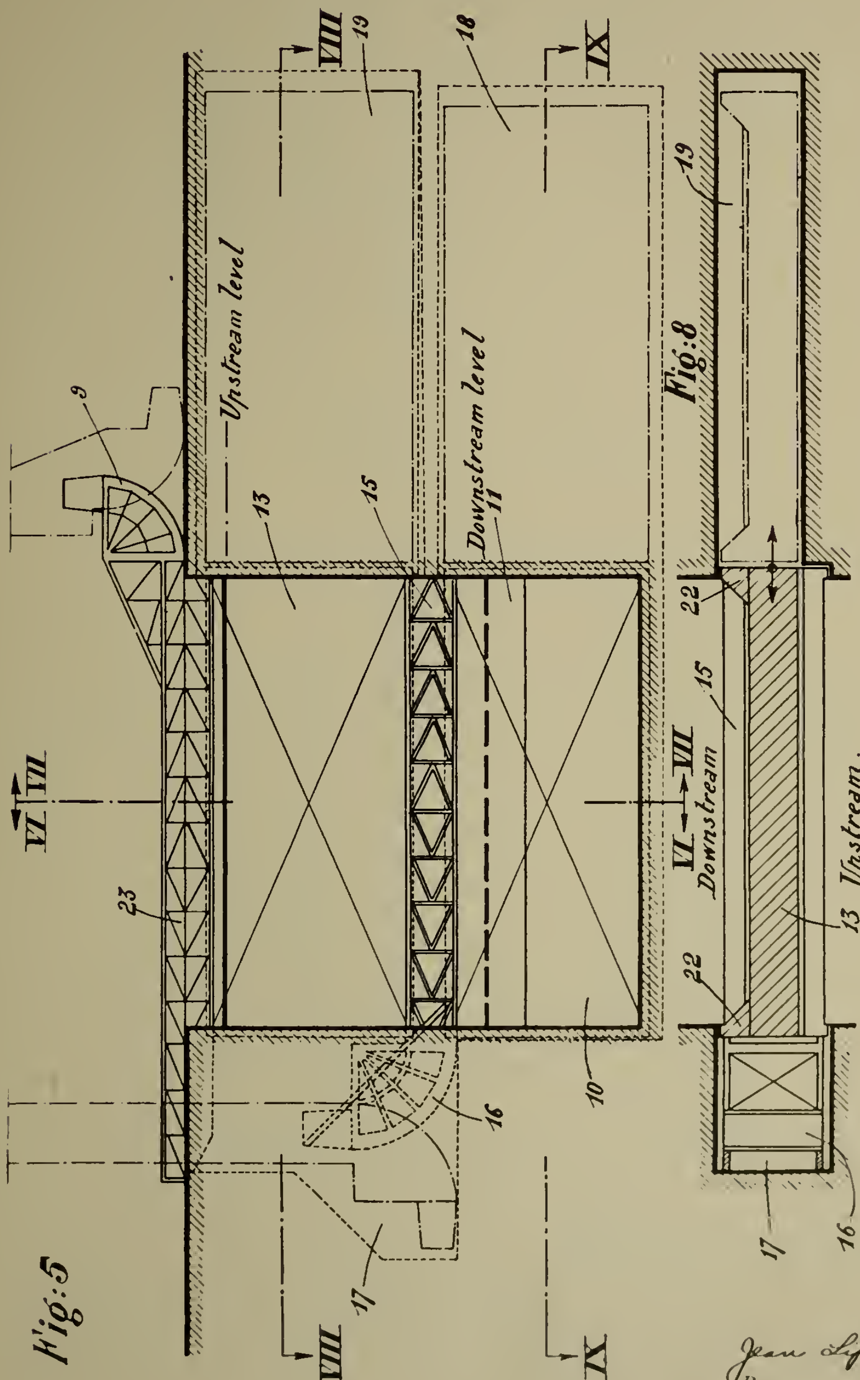

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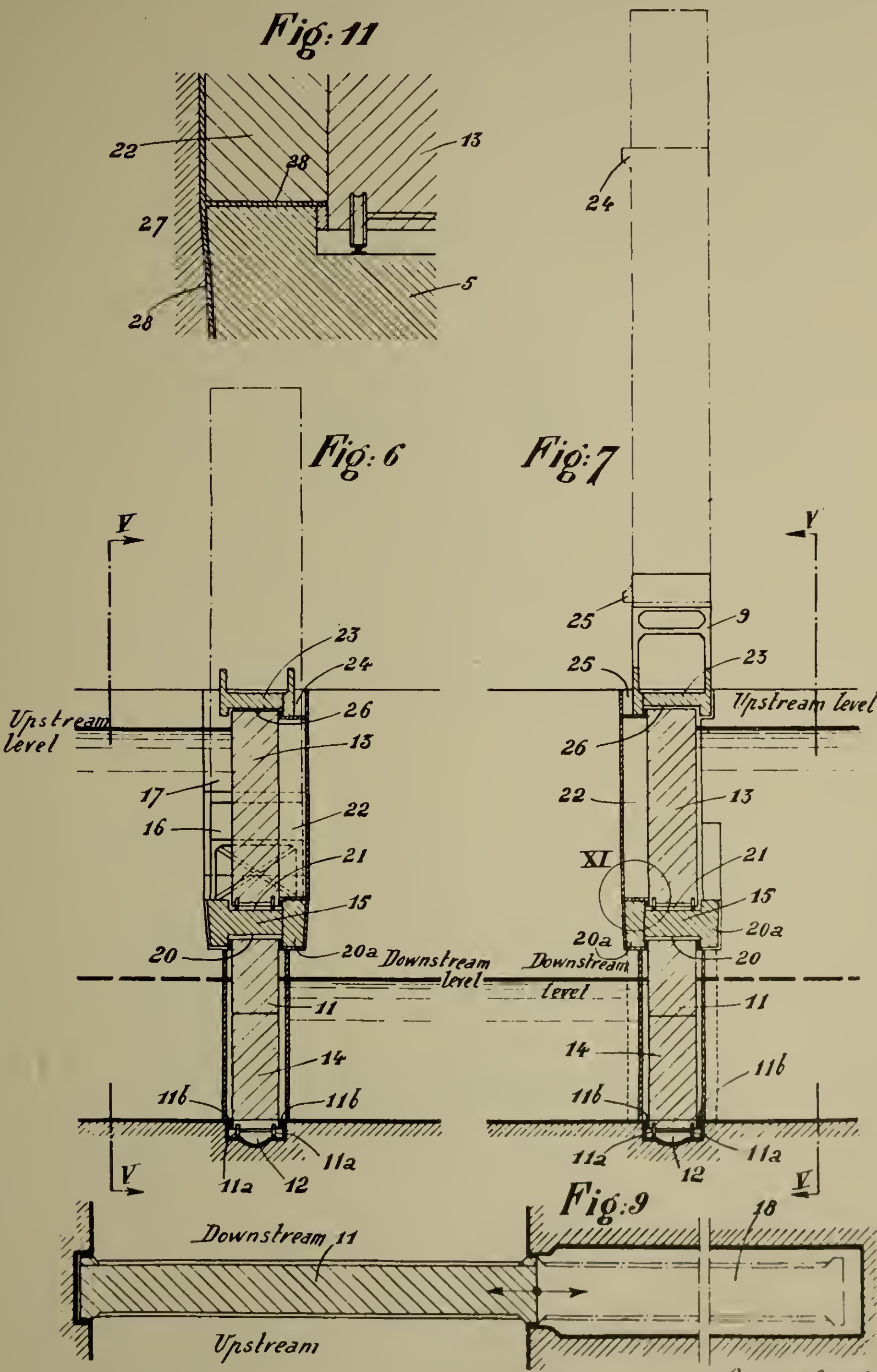

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7 Sheets-Sheet 5

Fig: 12

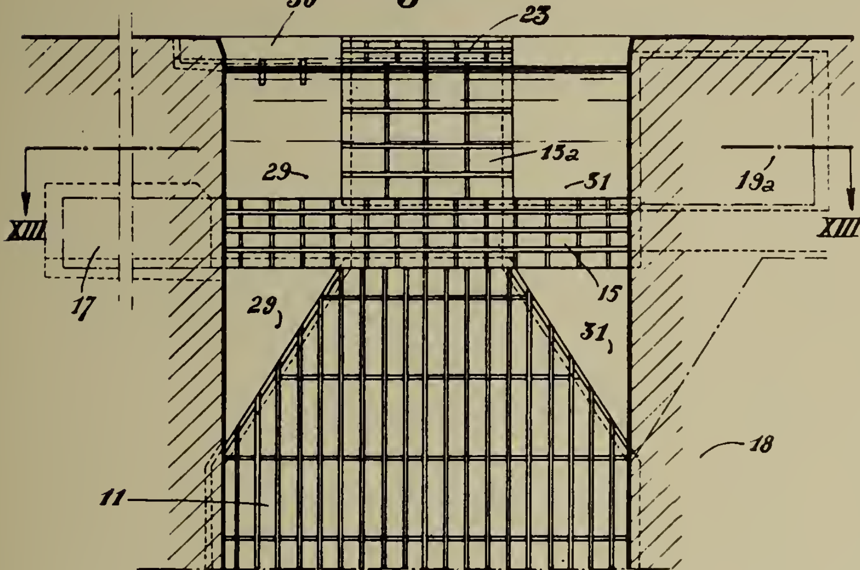

Fig: 13

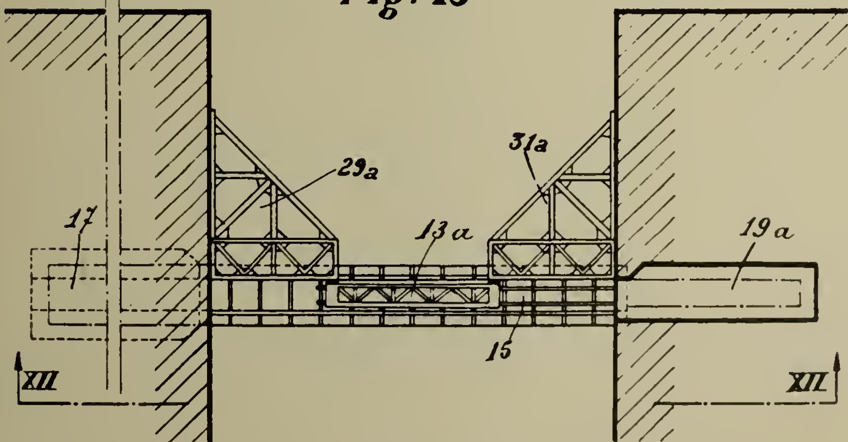

Fig: 16

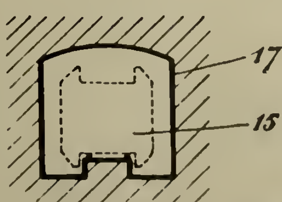

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Fig: 14

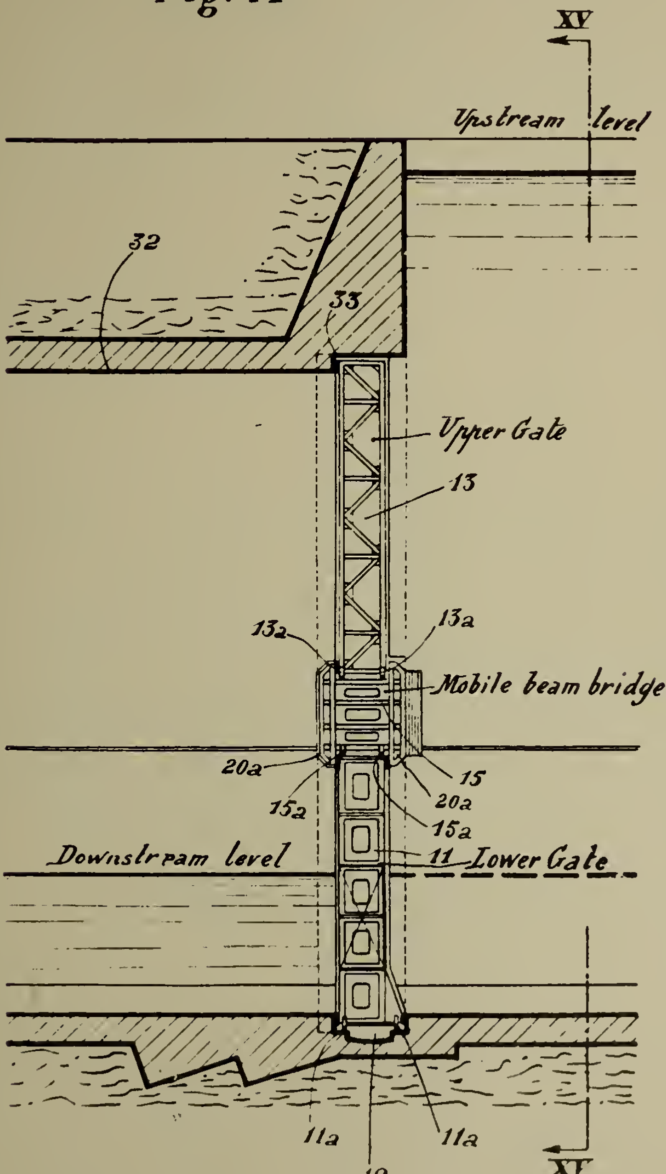
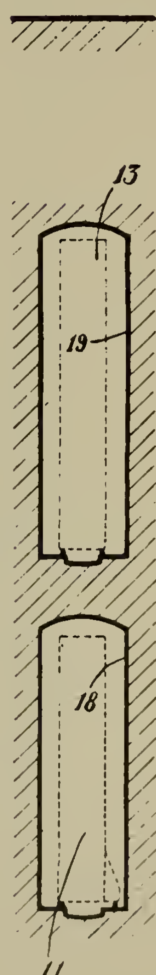


Fig: 17



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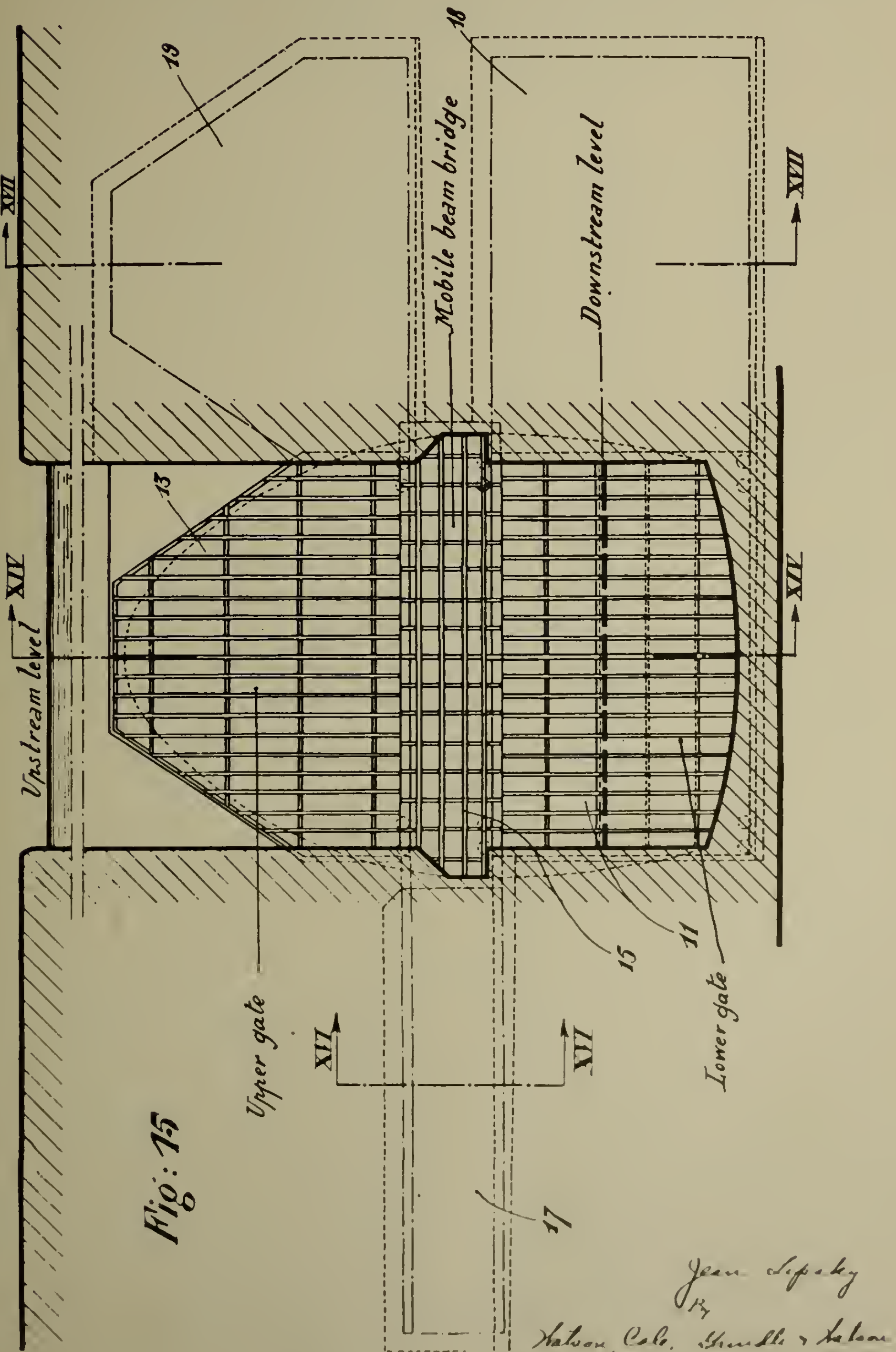

Fig: 15

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ALIEN PROPERTY CUSTODIAN

FUEL TANK WITH EMERGENCY SUPPLY FOR MOTOR-CARS AND THE LIKE

Fritz Fiedler, Munich, Germany; vested in the Alien Property Custodian

Application filed September 17, 1941

The invention represents an improvement of devices serving for preventing the fuel tanks of motor cars of being completely emptied, by the drain pipe of the fuel pump not extending directly into the fuel reservoir but into a tipping-cup mounted in this latter so as to be rockable, this tipping-cup excluding for the first, in its horizontal position, the remainder of fuel being below its upper edge from being consumed, thus the engine misfiring after the tipping-cup being emptied. Thereupon, by means of swinging the tipping-cup in a vertical position, the driver may cause the drain pipe to dip into the remaining quantity of fuel, and consequently render possible its being consumed.

The forms of embodiment hitherto realized requiring a relatively great expense of space and stipulating special devices on the fuel tank itself which are rather delicate in its mounting, their improvement became necessary. As far as this the supplementary introduction of the emergency device has not been possible in any tank. Furtheron with the preceding designs it may happen that the float holding the tipping-cup is raised by waves of fuel, thus the cup returning unintentionally into its initial position, by means of which fuel feed will be suspended.

The improvement according to the invention consists in all the single members which belong to the reserve supply device, being combined in a self-dependent structural unit of but low need of space. This will be obtained by attaching to the tipping-cup itself floating members to return the latter, upon refilling the fuel tank, into the horizontal position for maintaining a reserve supply; the floating members being arranged in such a manner as to—when being out of the fuel, in consequence of their net weight, and the tipping-cup being in its position for keeping a fuel reserve—exert a torque on the latter so as to dip it into the remaining quantity of fuel. The tipping-cup is held in its reserve position by a catch and has an electric switch which is sensitive to position and closes, with the cup being tipped downwardly, the circuit of a signalling device. With this the switch may comprise e. g. a rolling ball, or it may be designed as a mercury interrupter. Furtheron the electromagnet for releasing the catch may be traversed, commonly with a further magnet for moving a signal-disc, by a steady feeble current which by means of operating a push button switch can be led either exclusively in the magnet for the catch apart or in that for the signal-disc, so that the magnet in consideration will enter into operation. A lever attached to the signal disc locks with the cup being tipped downwardly the push button switch. Furtheron a weight may be attached to the periphery of the tipping-cup, said weight holding the latter in both its end positions abutting against stops by means of exerting a corresponding torque, the swinging of the tipping-cup being produced, with this, by a rotary magnet mounted on its shaft.

In the drawing two forms of embodiment of the invention have been represented; in which drawing

Fig. 1 shows a section through the new reserve supply device in its initial position with the fuel tank being filled, whereas in

Fig. 2 the tipping-cup is illustrated to be swung;

Fig. 3 shows the form of embodiment of the tipping-cup provided with a weight in its initial position, and

Fig. 4 the same form of embodiment with the cup being tipped upwardly.

The fuel drain pipe is designated by 1, said pipe extending into the fuel tank and the lower end of which may be surrounded by a sieve 2. The drum-shaped tipping-cup 3 is able to swing on the shaft 5 guided in the bearing piece 4 which is attached to the fuel drain pipe, and comprises on its upper side-parts floating-members 6 as well as a recess 7. With the tipping-cup 3 being in its horizontal position a catch 8 will engage with the recess 7, said catch being rockably mounted on an angle member 9 which is attached to the fuel drain pipe 1, and being submitted to the action of an electromagnet 10. To the tipping-cup 3 there may be fixed a switch sensitive to position comprising e. g. a cylindrical guide 11 in which a ball 12 is freely movable and which is closed at its open end by a leading-in contact inserted in insulation material. Likewise an mercury-interrupter may be used.

The connection of the device is as follows:

From battery 14 one pole of which has mass-connection, a line is leading to the push button switch 15 whilst a parallel-line is conducting through electromagnet 16 for the signal-disc 17 to the connecting terminal 18 of the other electromagnet 10 and from there to the leading-in contact 13 of the switch 11, 12. The signal-disc is held in its position of rest by means of a spring 18 and shows an extension 19 which, with the signal put in circuit, is abutting against an extension 20 of the switch 15 thus locking the same.

With a further form of embodiment according to Figs. 3 and 4 a weight 22 is placed on the outer

edge of the semi-circular tipping-up 21, said weight causing the tipping-cup, by exerting a corresponding torque, to bear in the position of rest against a stop 23 and, while being tipped, against the fuel drain pipe which serves as a stop, thus holding the cup in both its end positions. With the cup 21 being tipped and the fuel level descending the mass of weight 22 will be assisted still by the weight of the float 24. In this form of embodiment the tipping-cup 21 may be swung by means of the armature 26 of a rotary magnet 27 which may be excited by a switch, said armature 26 being mounted on the shaft of the cup 21. Instead of the switch 11, 12 sensitive to position provided for according to Figs. 1 and 2, in this case stop 23 may be designed as a simple push-button switch.

The manner of action of the device is as follows:

With the fuel tank being filled and a predetermined supply being kept, the tipping-cup 3 is in the horizontal position as shown in Figs. 1 and 3. If, now, the fuel level descends to the upper edge of the tipping-cup 3, this latter will prevent further fuel from flowing to the drain pipe 1, and the engine will begin misfiring as soon as the quantity of fuel still being in the cup 3 itself has been consumed. By means of depressing the push-button switch 15 which may be placed e. g. in the instrument board of the vehicle, now the driver has the possibility of rendering accessible to consumption the quantity of fuel supply being below the upper edge of the tipping-cup 3. Whereas, to mention this, the steadily flowing feeble current of the battery 14 is insufficient for exciting both the magnets 15 and 16 simultaneously as their total resistance is so great, upon closing the switch 15 the current will be led solely in the magnet 10, this latter thus responding and raising catch 8. Consequently the now released tipping-cup 3 will rock downwardly under the influence of the weight of the float member 6 and dip into the fuel, whereby the supply of fuel towards the drain pipe 1 is established. Owing to the tipping movement of the cup 3 the ball 12 has also changed its position in the guide 11, i. e. it has rolled to the now lowermost place thus establishing mass-connection with the terminal contact 13. The battery-current is now flowing—the push button switch 15 is already open—solely through the magnet 16, which on his part brings the signal-disc 17 into a position attracting the attention of the driver. With this the extension 19 of the signal-disc 17 locks the push button switch 15 against further operation, what would have the consequence of short-circuiting the battery-circuit. If the fuel tank is again refilled the floating-members 6 bring the tipping-cup back again in its horizontal position, until the catch is jumping in. Now the switch 11, 12 is opened by the ball 12 rolling back, and the signal-disc 17 returns under the action of spring 18 into its position of rest. It is quite obvious that any other visible or audible indicating device, e. g. or buzzer, a horn or the like, may replace the signal-disc 17.

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FUEL TANK WITH EMERGENCY SUPPLY FOR MOTOR-CARS AND THE LIKE

Filed Sept. 17, 1941

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2 Sheets-Sheet 1

Fig. 1

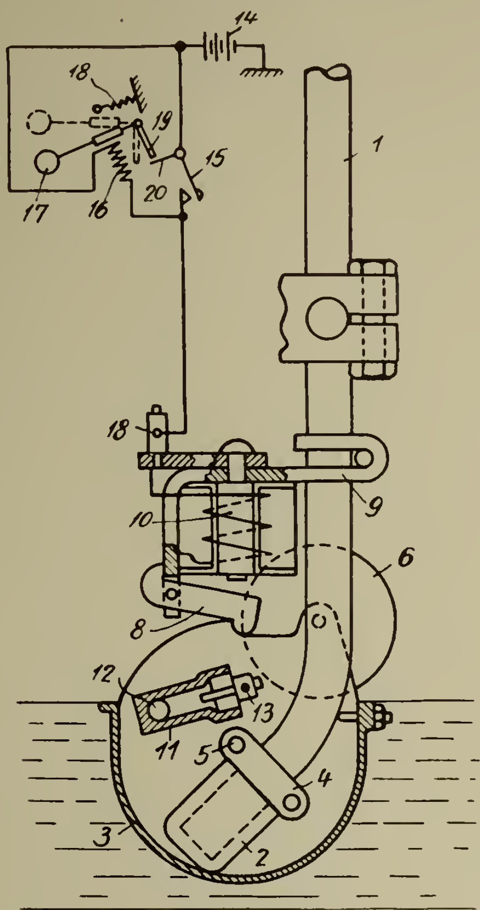
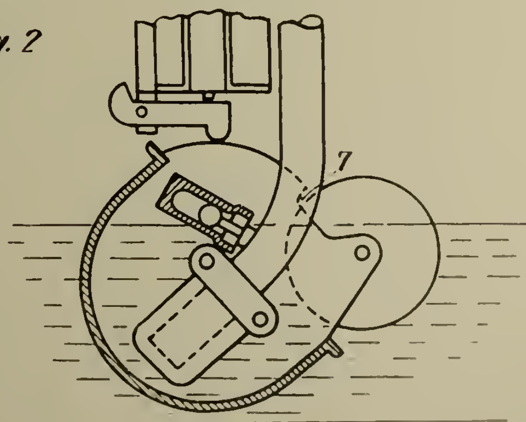


Fig. 2



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2 Sheets-Sheet 2

Fig. 3

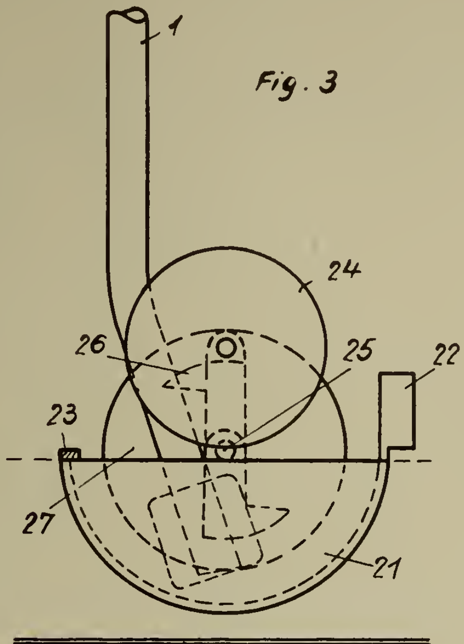
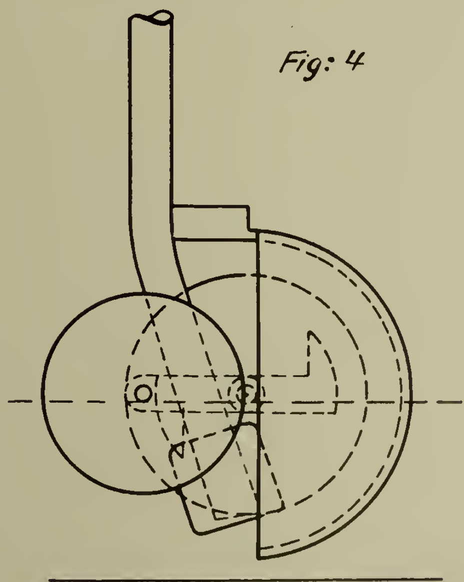


Fig: 4



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Published June 1, 1943

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ALIEN PROPERTY CUSTODIAN

RESERVE SUPPLY SYSTEM FOR MOTOR VEHICLES

Otto Michelmann, Eisenach, Germany; vested in the Alien Property Custodian

Application filed September 17, 1941

The invention relates to an improvement of such devices avoiding the complete emptying of the fuel tank of motor vehicles by providing that the drain pipe of the fuel pump is not discharging directly into the tank but into the tipping cup rockably mounted in the tank, which tipping cup in its horizontal position prevents the fuel rest below its upper edge from being consumed, so that the engine is missing after the tipping cup being emptied by suction. By moving the tipping cup into a vertical position, the operator will be able to effect the dipping of the drain pipe into the remainder of the fuel thus permitting its consumption.

The present invention resolves the problem in a remarkably more reliable and safer way, particularly as to the operation of the device and the automatic return, than the previous devices of the above mentioned type.

Special importance has been attached to the arrangement of the elements of the electric switch system from reasons of safety outside the easily inflammable fuel and to the possibility of an easy mounting and removal of the device into or from the fuel tank as a self-contained unit.

The forementioned favourable result is obtained e. g. by the fact that the fuel drain pipe with the tipping cup is mounted on a casing forming the cover for the opening for the insertion of the device into the fuel tank, which casing contains in a potlike recess also the electromagnet for the tipping cup, said recess having another cylindrical extension into which through a bore the contact plug of the magnet armature is projecting and which is closed outwardly by an flexible fuel-tight diaphragm. The diaphragm has on its outside the counter-contact for a leading-in contact attached to the casing for an electric indicating device and is capsuled with the contacts by a cover closing the potlike recess in the casing. The floating members which serve to return the tipping cup into the position for retaining reserve fuel are mounted on levers arranged to swing about the bearing axle of the tipping cup. When replenishing the tank with fuel with the cup tipped up a torque is exerted on the tipping cup owing to the lifting action on the floating members caused thereby, so that the said cup is again returned into its initial position. The floating members can bear in their end positions against limiting stops and the tipping cup can be held tipped up by a catch spring, a pawl or the like.

Two forms of embodiment of the invention are shown in the drawing in which

Fig. 1 is a side elevation of one form of embodiment of the system and

Fig. 2 is a top view of the tipping cup and of the floating members after cutting away the upper part by a section along the line A—A of Fig. 1.

Fig. 3 is a side elevation of another form of embodiment of the system.

Fig. 4 is a top view of the tipping cup and the floating members after cutting away the upper part by a section along the B—B of Fig. 3 and after removal of the pawl levers.

Fig. 5 is a top view of the pawl levers of Fig. 3.

Fig. 6 is another view of the lower part of the magnet armature from which the bifurcation of the connecting elements is to be seen.

Fig. 7 is a top view of the upper part of the device after removal of the cover.

With the device represented in Fig. 1 the tank wall **1** has an opening for the insertion of the potlike casing **2** serving for the reception of the fuel drain pipe **3**—which can be connected at **15** with the conduit leading to the engine resp. to the carburetor—and for housing the electromagnet **4**. The electromagnet **4** has internally and externally a fuel tight cover. The magnet armature **5** has above a contact plug **6** and below a pin with which it can be guided within the magnet casing **8**. The magnet casing has above a cylindrical recess **9** which may be concentrically to the passage boring for the contact plug **6** and which is tightly closed by a flexible diaphragm **10**. In the center of the diaphragm a countercontact **11** is provided opposite to the leading-in contact **12** which is elastically secured to the casing **2**. The potlike recess of the casing **2** can be closed by a cover **10** so that both the diaphragm **10** as well as the contacts **11**, **12** are protected. Secured to the fuel drain pipe **3** is the axle **16** on which the tipping cup **14** is rockably suspended. The tipping cup **14** can be so counterbalanced by counterweights **17** that the latter ones have a slight overweight. Eccentrically at the tipping cup **14** there are two lateral arms **18** with which e. g. the bifurcated connecting elements **19** to the magnet armature **5** are engaging in eyes **20** and **21**. Independently of the tipping cup **14** there are still the levers **22** mounted for rotation about the axle **16**, which levers carry at one end the floating members **23** and at the other counterweights **24**. The counterweights **24** are so dimensioned that they do not completely balance the weight of the floating members **23** which will cause them with a corresponding low fuel level to bear against stops **25** attached at the fuel drain pipe. The levers **26** carrying the stops **25** are so designed that they

are providing at the same time the stops 27 for the edge of the tipping cup 14 which is held in place under the influence of the weight 28 put on its edge. A transverse member secured to the fuel drain pipe 3 and corresponding sheet metal lugs 30 on the floating members 23 are serving as abutment for the latter in their topmost position. The weight 28 may have a recess 31 for the reception of the fuel drain pipe when the tipping cup 14 is tipped up and further serve in cooperation with a catch spring 32 to hold the tipping cup 14 in this position.

The mode of operation of the device is the following:

If the fuel level has sunk to the upper edge of the tipping cup 14, the engine will stop after having consumed the quantity still in the tipping cup 14. The operator now closes the circuit of the electromagnet 4 thus effecting an attraction of its armature 5 and simultaneously by means of the linkage 19 a movement of the tipping cup 14 of *abt* a right angle. This will cause the contact plug 6 to press the diaphragm 10 upwards and the closing of the contacts 11, 12 upon which a indicating device, a flashing light or the like will enter in action. The tipping cup 14 is held in this position by the catch spring 32 snapping in behind the weight 28. Owing to the low fuel level, the floating members 23 bear against the stops 25. In consequence of the lifting of the arms 18 when tipping the cup, said arms reach to the other side of the center of rotation into the vicinity of the double-armed lever 22. If now fuel is replenished, the floating members 23 are lifted from its supports 25, so that the levers 22 carry with them the arms 18 and therewith the tipping cup, which causes the weight 28 to snap out of the catch spring 32 and the tipping cup 14 to fall back into its initial position. The floating members 23 will raise simultaneously with the fuel level until the sheet metal lugs 30 abut against the transverse member 29.

One form of embodiment with a slight modification of that described hereinbefore is represented by the device shown in Figs. 3 to 7.

Compared with the form of embodiment described above the composition of the single elements of the device to form a constructional unit has remained unchanged, for also in this case it is possible to insert the device as a whole into the aperture provided therefore in the fuel tank. The upper part of the device including the electric installation and the lower one arranged near the bottom 40 of the fuel tank are interconnected by the fuel drain pipe 41 which is rigid enough for being able to carry the lower part with the tipping cup 42 and the floating members 69 and to resist the forces occurring in consequence of the operation of the device and following the movement of the fuel in the tank.

The upper part of the switch system is comprising the potlike casing 45 inserted into the aperture of fuel wall 44, which casing can be closed by the cover 46. Through the bottom of the casing a hollow cylinder 47 provided with an attachment flange is projecting which serves as casing for the field coil 48 and is provided with a guide bushing 49 within which the magnet armature 50 is slidably arranged. The field coil 48 is in connection with the battery of the motor vehicle or another source of current in the vehicle and may be put in circuit e. g. by a switch or push button on the instrument board of the car.

In the hollow interior of the magnet armature 50 is arranged the pin 52 and guided in the bush 53 under the pressure of a spring 51 consisting of a stainless material. The guide bushing 49 is enlarged at its upper end for the reception of the diaphragm 54 which tightly closes the guide bushing 49 but nevertheless permits a certain movability of the closure. In the enlargement is arranged the disc 56 supporting the diaphragm 54 against the pressure of the spring 55, a bore being provided in said disc for the passage of the pin 52. The spring 55 bears against the disc 57 of insulation material and against the bridge 58 which is secured to the casing 45 and electrically insulated from the remaining parts.

Centrically provided on the diaphragm 54 is the contact 59, to which the adjustable leading-in contact 60 secured to the bridge 58 is opposed. The contacts 59 and 60 are enclosed in the circuit of an indicating device, e. g. provided on the instrument board and fed from a source of current existent in the car. This indicating device may be a signalling disc, a incandescent bulb, a flashing light or the like. The spring 55 is so dimensioned that it will separate the contacts 59 and 60 with safety also with the highest liquid pressure that will occur. Leakage of fuel through the guide bushing 49 is prevented by means of the diaphragm 54 and all other points that may possibly permit leakage are made tight by packing rings or the like. In the same way also the field coil 48 is protected from access of fuel. In this manner the electric installation of the system is completely insulated from the easily inflammable fuel.

The fuel drain pipe 41 which is secured to the casing 45 and connected through the connection piece 61 of the casing with the fuel pipe conducting to the engine resp. to the carburetor is so dimensioned as to its length that it terminates adjacent the bottom 40 of the fuel tank. In the vicinity of the lower end of the fuel drain pipe 41 there is secured to it the axle 62, on which the tipping cup 42 is journaled in such a way, that the slightly curved lower part of the drain pipe 41, the cup edge being in horizontal position, terminates near the lowest point of the cup, but after the provided tipping of *abt* 90° it is no longer prevented from taking the remainder of the fuel in the tank.

The tipping cup 42 which, according to the desire to retain more or less reserve supply in the fuel tank is more or less high carries on both of its front faces an eccentrically arranged journal pin to which the fork-shaped linkage 64 (see Fig. 6) connecting the tipping cup 42 with the magnet armature 50 is hingedly connected. The length of the linkage 64 is made adjustable by means of the threaded member 65 connected therewith, which capable of being screwed into the magnet armature 50. The fixing nut 66 serves to maintain the adjusted length.

The weight of the linkage 64 together with that of the magnet armature 50 draws the tipping cup 42 into the position for retaining reserve fuel. Particular counterweights or balance weights—similar to those employed with the form of embodiment described in the first place—are not provided for this purpose with this form of embodiment. Only a projection 67 arranged at the edge of the tipping cup 42 will somewhat increase the weight, which is pressing the cup edge opposite the projection 67 against the stop 68 secured to drain pipe 41. There is perfect liberty how-

ever to use additional weights also with this form of embodiment, in case the pressure of the tipping cup **42** against the stop **68** is not sufficient to hold the tipping cup **42** with safety in this position.

Besides the tipping cup **42**, but independently of it, the floating members **69** are mounted for rotation about the axle **62** by means of the double-armed lever **70**. The floating members **69** are so counterbalanced by the counterweights **71** secured to the other arm of the levers **70**, that the weight of the floating members **69** plus the pressure on the floating members **69** exerted by the pawl operating levers **72** on the way, on which the floating members **69** release the pawl **73**, have together a slight overweight over the weights **71**. The lowermost position of the floating members **69** is likewise predetermined by the stop **68** correspondingly designed for this purpose. The topmost position of the floating members **69** is determined by their pivotal connection by means of the levers **70** e. i. the position which they occupy in the vertical position of these levers. To prevent the floating members **69** from coming into contact with the linkage **64**, this must be correspondingly curved. The turnover of the floating members **69** to the wrong side is prevented by the pawl operating levers **72**, which are under spring pressure. The pawl operating levers **72** and the pawl **73** rigidly connected therewith are hingedly connected to the bracket **74** attached at the fuel drain pipe **41**. A torsion spring **75** presses the pawl operating levers **72** on the floating members **69** so that when the floating members have trespassed a predetermined low position and the tipping cup **42** are tipped up by the magnet, the pawl will snap in behind the projection **67** and the tipping cup **42** remain in this position. The pawl **73** is prevented from falling too low as long as the tipping cup **42** not yet tipped up by the stop **76** secured to the bracket **74**.

The mode of operation of the form of embodiment described in the last place differs only slightly from the form of embodiment described in the first place. If the operator closes the circuit of the magnet, after the fuel level in the fuel tank has fallen as low that there is only just the emergency supply in it, the magnet armature **50** will be drawn into field coil **48** and consequently the tipping cup **42** tipped up so that the fuel drain pipe **41** can take up the emergency supply. The tipping cup **42** is held in this position by the pawl **73** till the fuel level in the tank when replenishing is so far up, that the floating members **69** release again the pawl **73** with the help of the pawl operating levers **72** and permit the tipping cup **42** to fall back into its initial position. From this arrangement results that during the tipping up of the tipping cup **42** it is necessary to lead the current only temporarily through the field coil **48**. There is no need of current for holding the cup in the tipped up position. The electric signalling device will operate however until the tipping cup **42** is again returned to its initial position in order to remember the operator all the time during which fuel is taken from the emergency supply that the fuel tank must be replenished at the first opportunity offering itself.

This mode of operation of the signalling device is realized by the fact that the spring loaded pin **52** inserted into the magnet armature **50** will bring the contacts **59** and **60** into contact with each other by pressing from below against the diaphragm **54** when the magnet armature **50** is drawn into the field coil **48**. The stronger spring **51** in this case will overcome the weaker spring **55**. Owing to the spring loaded arrangement of the pin **52** the connection of the contacts **59** and **60** will rest assured also in the case of changes in the length of stroke. The contacting pressure and the deflection of the diaphragm **54** too will always remain almost equal.

The shocks of the fuel waves that may eventually occur on the parts of the device submerged by the fuel can be prevented from doing any harm by surrounding the tipping cup **42**, the floating members **69** and eventually also the linkage **64** with a screen or lattice **77**, which e. g. may consist of two halves of a box joined together. In this case the aperture for the insertion of the device and the cover **45** should be made somewhat larger than shown in the drawing in order to permit the insertion of the device into the fuel tank.

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Serial No.
411,177
3 Sheets-Sheet 1

Fig. 1

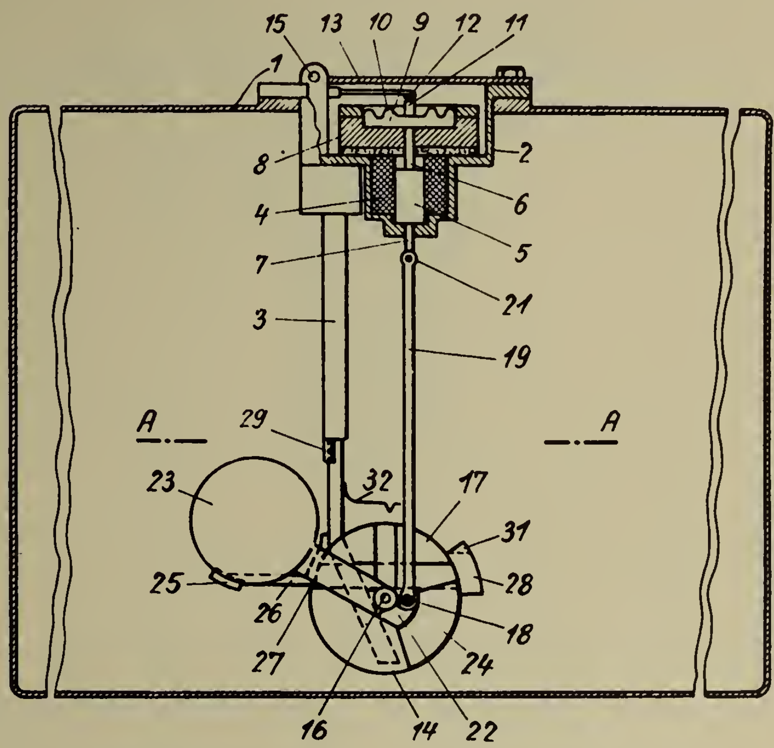

Fig. 2

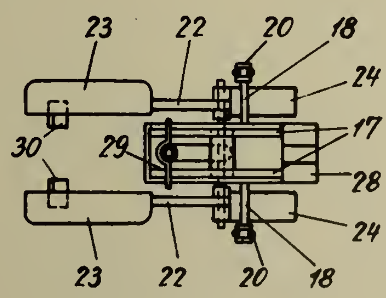

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Fig. 3

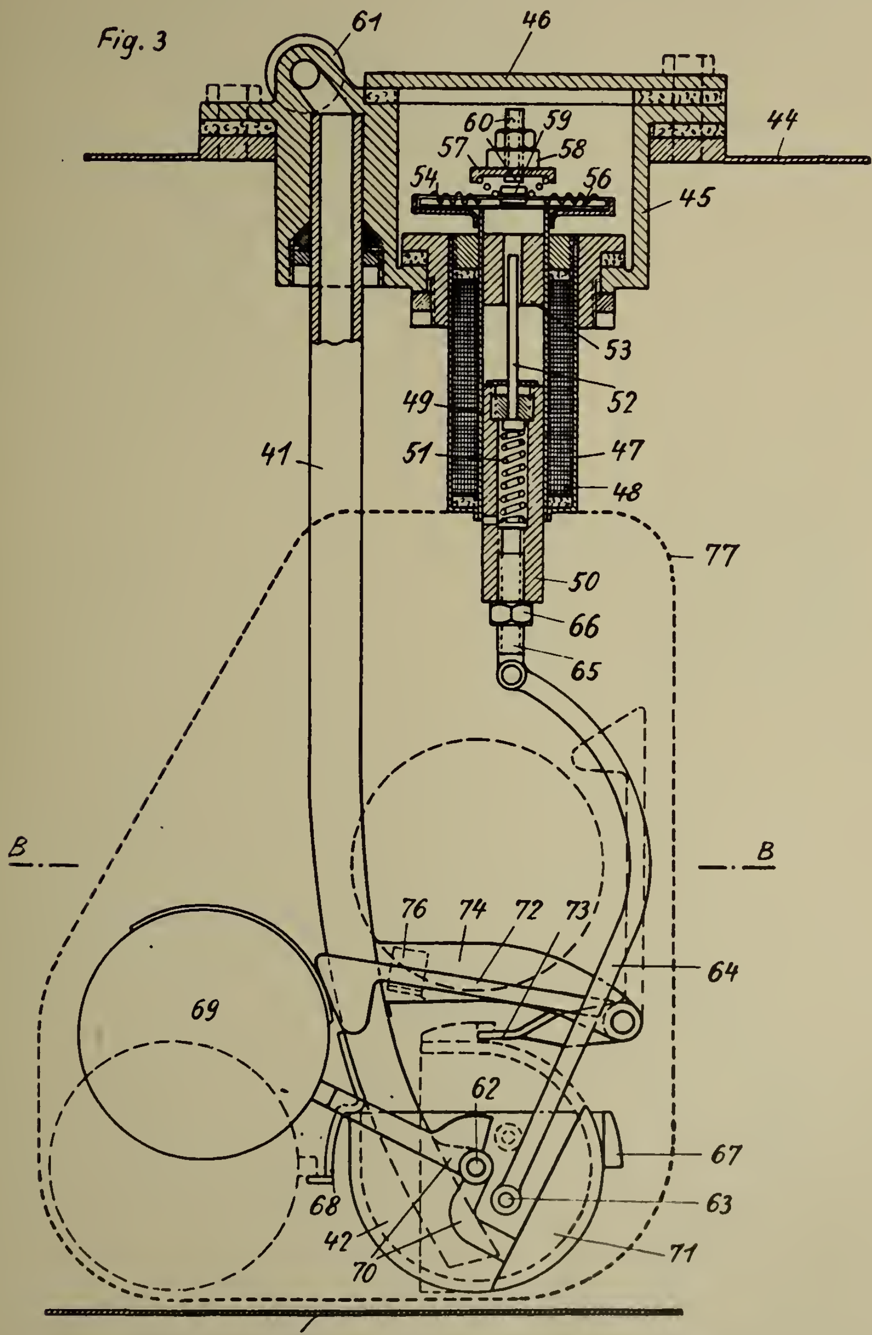

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Fig. 4

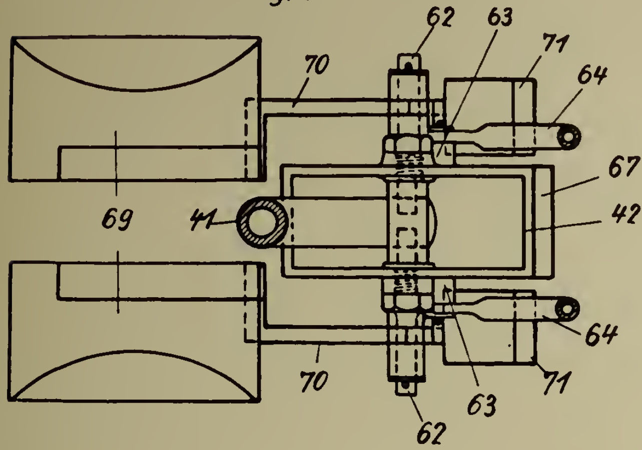


Fig. 5

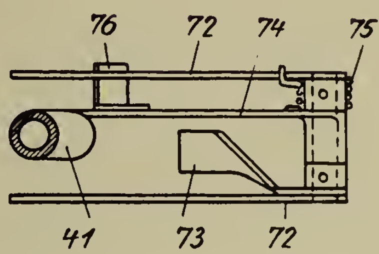


Fig. 6

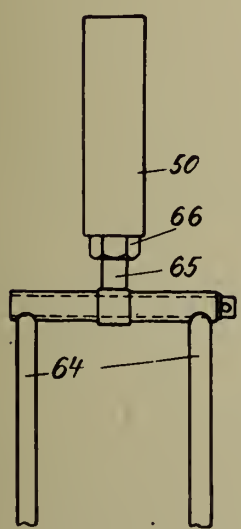
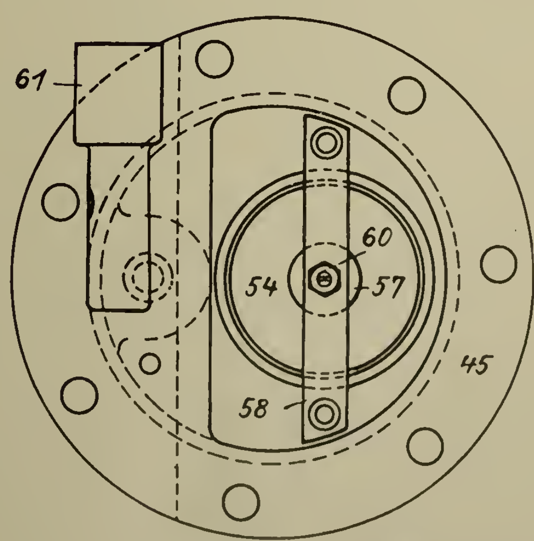


Fig. 7



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ALIEN PROPERTY CUSTODIAN

ELECTRIC CIRCUITS

Jérémi Malczewski, Lyon, France; vested in the Alien Property Custodian

Application filed September 26, 1941

The present invention relates to electric circuits of the kind of the ignition circuits of internal combustion engines (and especially airplane engines) including mechanical connectors of the so-called "straight pin" type, that is to say connectors capable of ensuring an electrical connection between two pins included in respective elements of the circuit that is considered, these elements consisting respectively, for instance, of the central electrode of a spark plug and the electrical conductor leading thereto.

Various solutions have already been proposed for the construction of these connectors.

For instance, it is possible to make use of a tubular piece of steatite, of bent shape, into the ends of which the pins in question are engaged. But a piece of this kind has no sufficient mechanical resistance and it is difficult to mould. Furthermore the evacuation of heat is not satisfactory and the device may get exaggerately hot.

Another solution consists in having recourse to an insulating connector made of mica mounted on the inside of a suitable junction box. In this case also the evacuation of heat is far from satisfactory and furthermore the system is rather expensive.

Finally, it has also been proposed to mount both of the pins inside a junction box one wall of which may eventually be made of mica. With such an arrangement, better conditions are obtained from the point of view of heat evacuation, but, on the other hand, the electric insulation that is obtained is exclusively of the air type and may prove insufficient due to condensation.

The object of the present invention is to provide a mechanical connector for electric circuits of the type above mentioned which eliminates the drawbacks just above mentioned and ensures the best possible conditions concerning heat dispersion and electric insulation.

With this object in view, according to the invention, the connector is arranged in such manner that the electric insulation around the pins or electrodes is of the mixed type, that is to say includes both an insulating material, which may surround the electrodes only partly, and air.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 is a sectional view, on the line I—I of Fig. 2, of a portion of an armoured ignition circuit including a spark plug, the conductor that feeds current thereto and a connector made according to an embodiment of the present invention, interposed between these two elements;

Fig. 2 is a top plan view of the system illustrated by Fig. 1;

Fig. 3 is a sectional view on the line III—III of Fig. 1.

In the embodiment illustrated by the drawings, it is desired to establish an electric connection between, on the one hand, the pin, or central electrode, 1 of a spark plug 2, and, on the other hand, a second pin 3 included in the electric conductor 4 of an ignition circuit suitably sheathed at 5.

In the embodiment shown by the drawings, it is supposed that the pins are, as usual, of rectilinear shape, but it should be well understood that at least one of them might eventually have a curved shape.

According to the essential feature of the invention, as above set forth, the connector is arranged in such manner that the electric insulation is of the mixed type, that is to say ensured both by an insulating material, which may surround but a portion of the pins, and by air.

In order to obtain such a result, many specific arrangements may be used. It should be noted that the insulating material must preferably be provided at the places where the electrical insulation calls for the maximum care, with respect to the conducting material which constitutes the outer sheath or armour. The latter may be constituted by a junction box which is made of a shape adapted to the particular function to be performed by the connector.

For instance, supposing that it is desired, as shown by the drawing, to connect together two pins at right angles to each other, the connector is made as follows:

The insulating material 6 fills at least most of the spaces which are left free, on the side of the exterior of the angle formed by the axes of the two pins, between said pins and the wall of the junction box A.

But no insulating material is provided on the inner side, so as to leave a free chamber 7.

Preferably, box A is made of flat shape in the general direction of a plane passing through both of these axes, and the insulating material covers also the sides of the box in question, while it does not extend along the inner wall 8 thereof, whereby heat can radiate toward the outside through said last mentioned wall.

The above conditions may easily be complied

with by means of a single piece of insulating material which is U-shaped in cross section, as visible on Fig. 3. This shape of the insulating piece permits an easy moulding and unmoulding, and the insulating material can therefore consist of steatite or any other suitable substance.

It should be well understood that, concerning the pins, the insulating piece may be so shaped as to conform at least partly to the surface of said pins.

Furthermore, concerning the means for ensuring the electric connection between the pins, said means are advantageously carried by the insulating piece, which is, for instance, provided at **9** with a projection on which contact plates **11** are fixed at **10**, as shown by the drawing.

In Fig. 1, I have also shown, in a diagrammatic manner, at **12**, springs for ensuring contact between pins **1** and **3**. But of course any other suitable means can be used for this purpose.

Finally, concerning box A, it is made for instance of two metal half-shells adapted to be fixed to each other at **13**, by welding or in any other way. These shells form two apertures **14** and **15** to which can be fixed, through any suitable means of a conventional type, the two elements to be connected together, in such manner as to ensure the continuity of the armour sheath.

The junction box might, if necessary, be provided with corrugations or ribs in order further to improve the thermic evacuation.

Whatever be the particular construction that is chosen, I obtain a device the operation of which results sufficiently clearly from the preceding explanations for making it unnecessary to further describe it and this device has, over those of the same kind as have been used up to the present time, many advantages, among which the following may be cited:

Any exaggerate heating of the device is prevented;

The device is very simple and it can be manufactured at a relatively low cost;

Perfect electric insulation is ensured under the worst conditions;

The device is strong, including no delicate elements liable to break under the effect of stresses.

Of course, the invention is not limited to the particular application which has been above described with reference to the drawings, that is to say for ensuring connection between the central electrode of a spark plug and the electrical conductor of the ignition circuit through which current is fed to said plug.

JÉRÉMI MALCZEWSKI.

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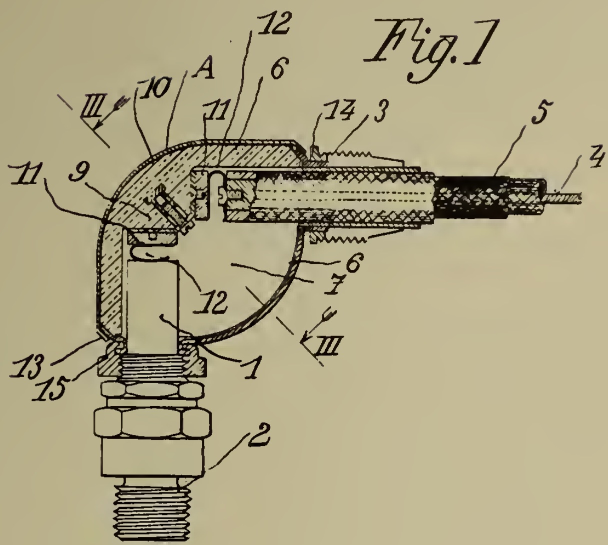

Fig. 1

Fig. 2

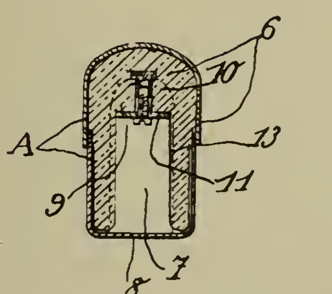

Fig. 3

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ELECTRIC CIRCUITS OF THE KIND OF THE ARMOURED IGNITION CIRCUITS FOR ENGINES

Jérémi Malczewski, Lyon, France; vested in the Alien Property Custodian

Application filed September 26, 1941

The present invention relates to electric circuits of the kind of the armoured ignition circuits for engines (and especially aircraft engines), including high voltage connectors adapted to establish connection between two plugs or pins carried by respective elements of the circuit, these elements consisting, for instance, of the central electrode of a spark plug and the conductor through which current is fed to said spark plug.

It is known that, in high voltage connectors of this kind, that of the pins which is in line with the central electrode of the spark plug must be made of suitable length so as to constitute a safety guard or protection and to prevent the possibility of sparks between the earth (metallic frame) and the contact plate carried by the end of said pin.

For high altitude flight, that is to say flight in a rarefied atmosphere, it is necessary to increase this safety guard or protection, which corresponds to increasing the length of this pin. But in the existing constructions, this increase of length involves a prohibitive size of the whole of the connector, especially when the pin of the leading-in conductor is in line with that of the electrode.

The object of the present invention is to provide a connector of the type above described which avoids the above mentioned drawbacks and, in particular, in which the protection is increased, by increasing the length of the pin in question, without increasing the overall length of said connector.

According to an essential feature of the present invention, the connector is made in such manner that the two pins between which an electric contact is to be ensured are juxtaposed over at least a portion of their length.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 is an axial sectional view, partly in elevation, of a portion of an armoured ignition circuit, including a spark plug, the conductor through which current is fed thereto, and a connector to be provided between said plug and said conductor, the whole being made according to an embodiment of the invention;

Fig. 2 is a side view corresponding to Fig. 1;

Fig. 3 is a sectional view on the line III—III of Fig. 1;

Fig. 4 is a view similar to Fig. 1, corresponding to another embodiment of the invention;

Fig. 5 is a side elevational view of the device of Fig. 4.

I will now proceed to describe the structures disclosed by the drawings, which relate to spark plug connectors for airplane engines intended to work at high altitudes.

The general arrangement is such that the metallic contact to be provided between the pin of the central electrode and the pin of the leading-in conductor is located as far as possible from the metallic body of the spark plug, without involving a substantial increase of the overall length of the device as compared with that of the usual constructions.

For this purpose, as above stated, according to a feature of the invention, the pins are mounted in such manner as to be juxtaposed over at least a portion of their length.

In particular, according to an advantageous embodiment of the invention, the parts are arranged in such manner that the portion of the circuit constituted by the two pins in question has an hair pin shape, with the branches of the hair pin corresponding to said pins, the electric connection between them being obtained through contact plates or other suitable means located on the end thereof which is most remote from the metallic body of the spark plug.

These general features may be embodied for instance in the following construction:

Concerning first the spark plug, it is made in any desired known manner, but its central electrode extends over a length greater than that which is usual, so as to form pin **2**, which is provided at its end with a contact plate **3**. This pin, which is supposed to be of rectilinear shape, and is provided with the usual outer insulating sheath, is for instance of a length of 50 mm. or more.

Concerning now the lead-in conductor **4**, which is supposed to be insulated as usual by means of an insulating sheath **5** and to be armoured through the usual means as shown at **6**, it terminates in another pin, of a length corresponding to that of the first, including, for instance, an insulating sleeve **7**, supposed to be rigid in Figs. 1 to 3 (and to consist of mica or the like). This second mentioned pin is provided, at its end, with a contact plate **8**, suitably mounted for ensuring electric contact with pin **3**, when both of the pins are engaged with each other.

Concerning the means for keeping the pins in this position, in which they are juxtaposed over at least a portion of their length, these means consist of a kind of box adapted both to ensure the guiding of said pins and to complete the insulation while ensuring the continuity of the armouring.

Furthermore, this box will be made in such manner that it permits of easily separating and removing one or the other of said pins.

Of course, anyone skilled in the art can imagine many embodiments of such a system, but I will describe two preferred embodiments illustrated, by way of example, by the drawings.

In the embodiment of Figs. 1 to 3, the system includes the following elements:

(*a*) A metallic shell **9**, mounted in a removable manner on the body of the spark plug, for instance by means of a nut **10** adapted to apply against said body a flange such as **10**^{1}, said shell being further provided with an aperture **11** through which the lead-in conductor is introduced, making a bend of 90°, for instance;

(*b*) Insulating means, in the form of a cap **12**, of moulded or other insulating substance, adapted to cover both of said pins **2** and **7**, said cap being, for instance, of general rectangular shape, bearing at its base against the edge **13** of shell **9**, and advantageously including two longitudinal grooves **14** for the guiding of the pins; and

(*c*) A metallic cover **15** adapted to surround the whole and fixed thereon in any suitable manner, for instance, by screwing or by welding;

In the embodiment of Figs. 1 to 3, this cover **15** is supposed to be fixed by screwing, which can be facilitated, on the one hand, by the eventual presence of conical portions such as **16**, and, on the other hand by the provision of a spring clip **17**, for instance pivoted at **18**.

The electric contact is established between plates **3** and **8** through a spring **19** or in any other way.

In the embodiment of Figs. 4 and 5, the portions **9** and **15** of the above mentioned embodiment are combined into a single piece, preferably consisting of two halves **19**, stamped and welded together along lips **20**.

In order to permit of easily removing pin **7**, the latter may be constituted by a mere extension of flexible conduit **5**.

In this embodiment, I provide, in the bottom of insulating cap **12**, a contact piece **21** which serves to connect contact plates **3** and **8** together, with springs **19** interposed. This cap may, in this case also, be provided with guiding grooves **14**, and even cylindrical recesses, corresponding to the diameter of the pins.

Furthermore, in order to avoid flexible pin **7** having a tendency to escape, I may provide, at the inlet of aperture **11**, a tightening device including, for instance, a screw-threaded piece **22** rigid with said aperture, a flexible ring **23**, a pressure ring **24** and, finally, an outer tightening piece **25** which may, at the same time, serve to fix the armouring means **6**, at **6**^{1}.

Anyway, whatever be the particular embodiment that is chosen, I obtain a device the working of which results sufficiently clearly from the preceding description for making it unnecessary to enter into further explanations. This device has, over the devices used for the same purpose up to the present time, many advantages among which the following may be particularly cited:

The contact between the pins is located as far as possible from the spark plug body, which ensures the maximum protection against the formation of sparks;

The room occupied by the device is as reduced as possible;

The construction is extremely simple, the cap-shaped insulating portion being easy to remove from its mold, without fear of breaking it;

The cooling of the central electrode of the spark plug is facilitated, owing to the increase of its length; and

The lead-in conductor can be brought substantially to the level of the body of the spark plug, which further ensures a reduction of the space occupied by the whole of the ignition circuit.

It should be noted that at least one of the pins might be of curved shape instead of being rectilinear;

Furthermore, the contact between the two pins might be ensured in any suitable manner different from that described, and there may be any number of pins, in addition to those shown.

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Fig. 1

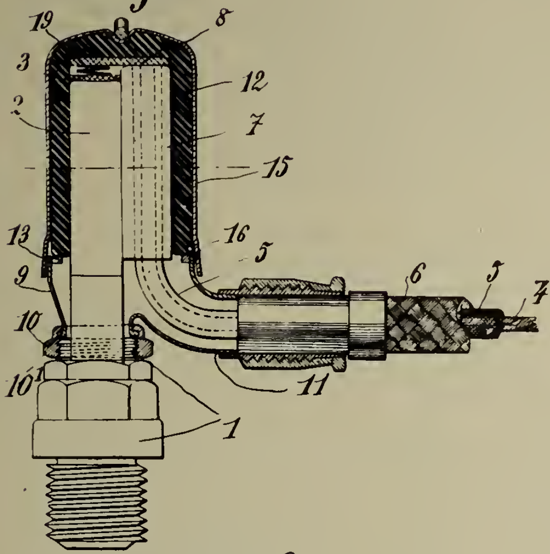

Fig. 2

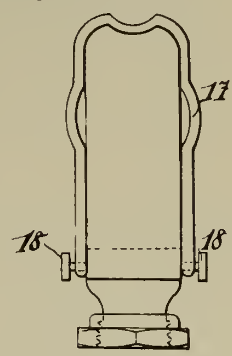

Fig. 3

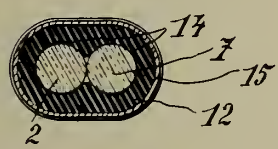

Fig. 4

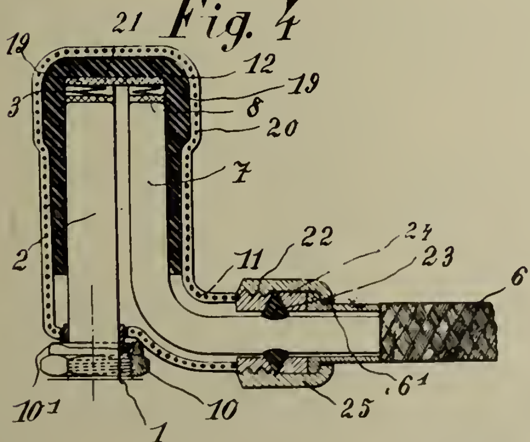

Fig. 5

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ALIEN PROPERTY CUSTODIAN

LOW-FREQUENCY INDUCTION FURNACES FOR FUSING IRON ALLOYS

Fritz Walter, Berlin-Friedenau, Germany; vested in the Alien Property Custodian

Application filed September 29, 1941

This invention relates to low-frequency induction furnaces for fusing iron alloys, particularly pig-iron castings and cast steel.

Low-frequency furnaces of the type hitherto known have as is well known a relatively complicated trough shape which calls for a particularly reliable furnace lining. When fusing metals at temperatures above 1000 degrees centigrade, the furnace lining is greatly stressed by the high temperatures. In addition, the intense agitation of the metal in the trough erodes the lining material which deposits on some points of the furnace where it is not desirable. The energy supply varies constantly so that an undisturbed operation for a considerable period can be ensured in some cases only. The temperature within the trough channel is also considerably higher than in the hearth. In brass melts in which temperatures slightly above 1000 degrees centigrade are in average employed, differences of temperature up to 150 degrees centigrade have been ascertained. These differences of temperature become still greater when fusing metals having a higher fusing point, such as, for instance, is the case with iron and pig-iron castings. Owing to the overheating of the metal in the trough, necessary for the fusion and the intense agitation of the metal in the bath, the masonry is attacked to a very great extent and withstands but a few melts. Improvements in the construction of low-frequency furnaces can therefore only be effected, if too great increases in temperature within the trough be avoided and the agitation of the bath prevented. When dimensioning the trough as has hitherto been usual, it is impossible to reduce the agitation of the metal in the trough, since otherwise an efficient energy supply is not possible. In the trough channel of the furnaces hitherto known, the current distribution over the cross-section of the trough is uniform. However, the magnetic lines of force over the cross-section are distributed in a very non-uniform manner so that an intense agitation of the metal in the bath must occur. However, if the trough is enlarged, the resistance of the fusing channel as is well known is reduced and therefore cos φ of the system so that condensers must be employed. Should the diameter of the trough or the width of furnaces of the rectangular type be small as is the case with the types hitherto employed, the alternating-current resistance decreases inversely proportional with the width of the trough. The alternating-current resistance therefore decreases if the trough becomes wider as a result of the erosion, thereby causing at the same time a decrease in the energy input.

In Fig. 1 are shown the above conditions graphically. The curve R_w shows the relations between the alternating-current resistance of a rectangular trough channel and the width b. The alternating-current resistance depends upon the frequency used and the conductivity of the metal fused which fills up the trough. The curve in Fig. 1 is computated for a frequency of 50 cycles and for pig-iron castings. In the case of cast steel the curve coincides substantially with that for pig-iron castings. When considering this curve, it results that the alternating-current resistance from a predetermined trough width, is practically dependent upon the trough width. A change in the cross-section of the trough has, therefore, no influence within this range on the conversion of energy. The alternating-current resistance tends to reach a limit value given by the following equation

$$R_w=\frac{1}{h.{}^1/\beta}.\varphi$$

where R_w is the alternating-current resistance, 1 the length and h the height of the trough channel. β is the absorption constantw hich is obtained by the following equation

$$\beta=2\pi.\sqrt{\frac{\mu.f}{\rho}}.10^{-9}$$

In this case it is assumed that ρ, the specific resistance of the metal fused be expressed in ohm/cm. The value of μ in the case of pig-iron castings is approximately 1. The frequency f is taken in the above instance as 50 cycles.

According to the invention the width b of the trough should be chosen in such a manner that the alternating-current resistance R_w is practically independent of the increase of the trough width. In this case, erosions which occur as a result of the agitation of the metal in the trough do not play any part for the fusing operation, since the energy input is no longer varied. Also cos φ does not vary. To this end, as will be seen from Fig. 1, the trough width must be greater than 12 cm. The distribution of current within the trough is not uniform. As a result of this non-uniform distribution of current, also the agitation of the metal in the fusing trough is brought about in particular ways. Only in the neighborhood of the lining material in the melt a pressure drop is to be expected which results in an agitation of the metal which is considerably slighter than in the case of the trough shapes as hitherto dimensioned. Owing to the large

cross-section, the pressure drop between the trough and the hearth proper is reduced so that also overheating are much more seldom than has heretofore been the case. The temperatures in the trough are lower than hitherto by 100 to 200 degrees centigrade. In this manner, there results a smaller mechanical stress of the lining and furthermore, better qualities of the products produced are obtained. The efficiency of the entire system increases.

Fig. 2 shows a sectional view of a furnace with two hearths denoted by the reference numerals **1** and **2**. The two troughs **3** lie exteriorly of the two induction coils **4** and have a width of more than 12 cm. By the width of the trough is understood the expansion in the direction A—B. The trough **5** arranged between the two induction coils is correspondingly wider at least 20 cm in the case of 50 cycles, since it is traversed from both sides by electromagnetical lines of force. The length of the trough is chosen in accordance with the desired input of the furnace. The laminated iron body is denoted by the numeral **6**. **7** is the lining material. A casting lip **8** serves to cast the fused metal. It is preferable to use the hearth **1** as the hearth proper, into which the parts to be fused are charged and to effect the casting from the hearth **2**. In this manner an homogeneous material is always attained for casting.

FRITZ WALTER.

PUBLISHED

JUNE 1, 1943.

BY A. P. C.

F. WALTER

LOW-FREQUENCY INDUCTION FURNACES

FOR FUSING IRON ALLOYS

Filed Sept. 29, 1941

Serial No

412,885

Fig. 1

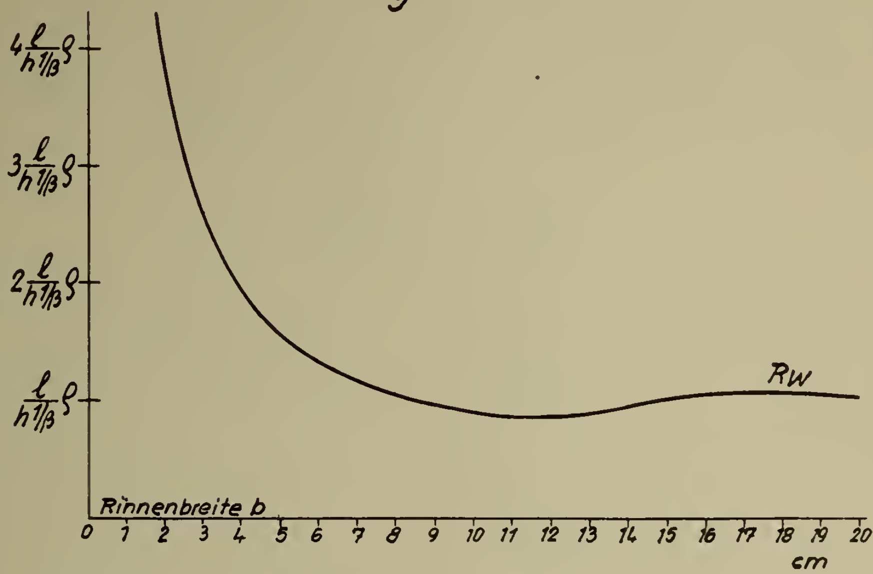
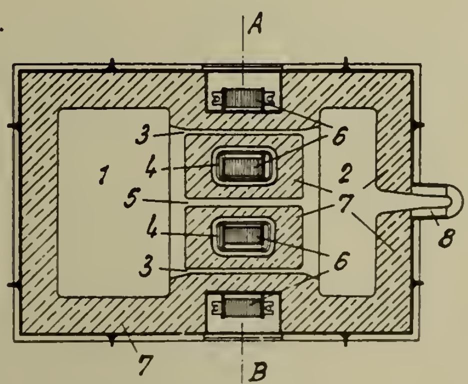


Fig. 2



Inventor

Fritz Walter

By Frederick E. Y. Turner

Attorney

Published June 1, 1943

Serial No. 413,906

ALIEN PROPERTY CUSTODIAN

STENCIL SHEETS

Shinjiro Horii, Kanda-ku, Tokyo, Japan; vested in the Alien Property Custodian

No Drawing. Application filed October 6, 1941

This invention relates to improvements in stencil sheets commonly used for duplicating written or typewritten matters, and more particularly to stencil sheets comprising a fibrous base provided with a normally impervious coating in which characters may be formed by the pressure of a stylus or the type of a typewriting machine.

Heretofore it has been proposed to prepare a stencil sheet consisting of a porous base, such as Japanese yoshino paper, coated with a material comprising a solution of vinyl resin, such as vinyl acetate or vinyl chloride, in volatile solvents, such as a mixture of toluol, alcohol and ethylene glycol monoethyl ether, and softening agents such as aluminium stearate, peanut oil and dibutyl phthalate.

The present invention is based upon the discovery that the coating material prepared by mixing and emulsifying an aqueous solution of polyvinyl alcohol with a tempering or softening agent in the presence of an emulsifying agent constitutes a highly efficient coating for stencil sheets, possessing an excellent flexibility and good durability.

Polyvinyl alcohol is a water soluble hydroxy vinyl compound which can be produced by the hydrolysis of polyvinyl acetate, carried out in a suitable liquid vehicle, under the influence of acid or alkali. Polyvinyl alcohol forms viscous and stable aqueous solution. The viscosity of the solution may be varied widely and it depends on the degree of the polymerisation. The aqueous solution of polyvinyl alcohol emulsifies easily with oily softening agents and can be mixed evenly with the aqueous solution or dispersion of organic colloids such as gelatine, casein and soybean protein. When a sheet of fibrous base is coated or impregnated with the above mixture and dried, a tough and flexible coating is obtained, which is unaffected by oily or greasy inks and has a good keeping quality. The coating also can be clearly cut through by the pressure of a stylus or the type of a typewriting machine.

In carrying out the invention, first a coating material is prepared by mixing and emulsifying an aqueous solution of polyvinyl alcohol, dissolved in hot water, with one or more of tempering or softening agents, such as mineral oils, fatty oils, fats, waxes, higher fatty alcohols, naphthenic acid glycerides, dibutyl phthalate, ethylene glycol and glycerine, in the presence of emulsifying agents such as Turkey-red oil and sulphate salts of higher fatty alcohols. There may be added, if necessary, an aqueous solution of organic colloids, such as gelatine, casein, soybean protein and methyl cellulose, hardening agents, such as formalin and butyl aldehyde, and coloring agents such as pigments or dyes. Then sheets of Japanese yoshino paper are impregnated with the coating material in drawing over the surface of the resulting solution, the surplus being removed by a scraper, and allowed to dry.

The proportions of the ingredients of the coating material may vary according to several circumstances. The following is an example:

	Parts by weight
2% aqueous solution of polyvinyl alcohol	500
2% aqueous solution of gelatine	100
2% aqueous solution of soybean protein	200
Turkey-red oil	50
Castor oil	30
Oleyl alcohol	50
Heavy mineral oil	20
Prussian blue	20
China clay	40

SHINJIRO HORII.

Published June 1, 1943

Serial No. 414,028

ALIEN PROPERTY CUSTODIAN

EXPLOSION AND INTERNAL COMBUSTION ENGINES

Henri Leopold Javal, Vichy, France; vested in the Alien Property Custodian

Application filed October 7, 1941

The thermal efficiency of explosion or internal combustion engines only attains a small part of the corresponding thermal energy, and the object of the present invention is to eliminate various causes of this waste of energy.

The compression absorbs indeed, as non motive work, a fraction of power which seems capable of a certain recuperation.

On the other hand, the thermal energy and the gas pressure attain a maximum upon explosion, when the piston is in the dead centre, i. e. at a non motive instant, the piston being locked by the position of the connecting rod in extension with the crank. The power given by the explosion therefore only yields useful work after the crankshaft has rotated by an arc sufficient for unlocking the piston and for causing the connecting rod to form with the crank an angle of sufficient height for exerting a useful pressure. This, however, results in a corresponding downward movement of the piston and thus the gas pressure has already decreased, so that the explosion power only has a useful effect when this power has been weakened.

Furthermore, the connecting rods are subjected, during the motor stroke, to harmful oscillation, and at no moment at all the connecting rods will work simultaneously with respect to the piston plane and with respect to the crankshaft under the most suitable angles for transmitting the maximum power with the minimum resistance.

A known means for improving the driving moment of the connecting rod consists in offsetting the cylinder axes with respect to the crankshaft in the direction of rotation. This however reduces the compression of the engine, and, at the upper dead centre this compression, reacting upon the foot of the connecting rod, will subject the crank pin to a harmful moment which, if the amount of offset is somewhat large, would have a tendency to stop the crankshaft.

The various drawbacks indicated above: braking effect due to the compression, inertia at the dead centre, insufficiency of driving torque, are corrected by means of the combination described below, where the suction and compression work are or may be effected by members distinct from the engine cylinder into which the compression will deliver at the beginning of the motor stroke of the engine piston, the combustion mixture or the air alone, already compressed or undergoing compression.

If this compression is ended during a fraction of the downward stroke of the engine piston or if the chosen ratio of compression be attained right at the beginning of filling, it will invariably itself set up upon the piston a driving work.

The explosion, then taking place, and due to the fact that the stroke of the piston is now free, the detent of the gas will also take place freely.

The explosion point is determined by the adjustment of the compressor, of its output in terms of the volume of gas used and of the compression ratio chosen. The cylinder shift is adjusted in terms of the explosion point, in a manner that the connecting rod be near to the perpendicular to the piston surface while forming an active angle with the crank.

By way of example and especially for well illustrating the invention, the latter will be explained according to a theoretical embodiment corresponding to the diagrammatic Figures 1 and 2 of the joined drawing.

This embodiment comprises an auxiliary cylinder 1 for suction and compression, with normally arranged axis, feeding two motor cylinders such as 2. For the sake of simplicity, only one cylinder has been shown on the drawing. The cylinders 1 and 2 communicate, at the upper part, by a pipe 1′ closed by any known means. On the drawing is shown a valve 13 in cylinder 1 and a valve 2′ in cylinder 2. Piston 3 of cylinder 1 is actuated by a connecting rod 4 by means of a crankshaft 5 driven by the engine crankshaft 6, but at a speed double of the latter. These two crankshafts rotate respectively in the directions indicated by the arrows 7 and 8. The length of crank 9 of the compressor is half that of the engine crank 10.

The angular shift of crank 9 with respect to crank 10 is adjusted in terms of the compression ratio as lagging by two units per unit of compression: for instance for a compression ratio of 6 a lag of $^2/_6$ or $\frac{1}{3}$ of stroke, i. e. that when the engine piston 14 is at the upper dead centre, the compressor piston 3 will be at $\frac{2}{3}$ of its stroke.

The capacity or volume of cylinder of compressor 1 is the same as that of each of the engine cylinders, such as 2, but since the stroke of piston 3 is only half, the bore of cylinder 1 is equal to that of cylinder 2 multiplied by $\sqrt{2}$.

The motor cylinders such as 2 are shifted with respect to the crankshaft axis by about $\frac{1}{10}$ of the radius of crankshaft 6.

The two cylinders 2 of the same group, supplied by one and the same compressor, operate at an interval of one stroke.

On Figure 1 the pistons are shown in the position they occupy at the moment when piston 3

arrives at two thirds of its stroke towards its upper dead centre, piston **14** of cylinder **2** being then at its upper dead centre owing to the adjustment indicated above. The gaseous charge (combustive mixture or air alone, according to the type of engine) has been drawn in by pipe **11** during the downward stroke of piston **3** and the valve **12** will now open. This charge has been compressed during the upward stroke up to the moment when piston **3** is in the position shown, the valve **12** being then closed. If the gaseous charge has been taken at atmospheric pressure, it will now be at a pressure of 3 kg/sq cm. Valves **13** and **2'** are then opened, compressor **1** communicates with cylinder **2**, piston **14** being, as already seen, at its upper dead centre.

The gaseous charge is then discharged into cylinder **2** while the pistons are moving, and this up to the moment when the pistons are in the position of Figure 2, where piston **3** is at its upper dead centre and piston **14** at ⅙ of its downward stroke. The gaseous charge will then have passed entirely into cylinder **2**, and in passing from ⅓ of the cylinder volume to ⅙, the pressure will have passed from 3 to 6 kg/sq cm. At this moment, the valves close and ignition is effected by any suitable device **15**. A grid or wire gauze muff, or any other known device **16** prevents the combustion or explosion to spread beyond the cylinder.

It will be seen that in this manner the compression is effected not in a closed vessel but on the surface of a piston at the beginning of the downward stroke. It assists the downward motion of the piston and produces motive power. Since the explosion is set up, in the considered case, at ⅙ of the stroke and the engine axis is shifted by the suitable fraction, the connecting rod will transmit the movement of the piston in a substantially straight line and the crank will have passed the dead centre by a sufficiently large arc and will be sufficiently inclined to the connecting rod for not opposing any resistance to its pressure. On the other hand, since the explosion takes place under the maximum of compression, but yet during the downward stroke of the piston, and on a piston the stroke of which is free, the loss of power due to the resistance of the dead centre has thus been eliminated.

It follows that the detent of the gases will take place freely and that the piston will be projected with the full force of the explosion. The energy of the gases will thus be transformed into work at a maximum.

The method of compression of the gases may be of any suitable type. For instance, the suction and compression cylinder and its crankshaft may be replaced by any other device and particularly by a turbo-compressor using, according to the known means, the force of the escape gases, the compressor capacity and speed being adjusted in order to give in each engine cylinder the chosen compression ratio during the corresponding fraction of motor stroke.

It should be observed that the combination described will further permit to change the characteristics of an engine, such as the bore and stroke, and even to increase both together, without changing the consumption, since the volume of admitted gases is not, as in the usual cycles, rigidly determined by the cylinder capacity, but only by the adjustment of the compressor and the chosen ignition point.

In the case of an internal combustion engine, air alone is being discharged into the engine cylinder, and the fuel is injected at the required moment for its ignition.

The invention is not limited to one type of engine, to one form of compression or one determined cycle, but applies to all engines, whatever their type, of which it is desired to increase the efficiency by setting up the explosion under the required compression, during the motor stroke and after a fraction of the stroke sufficient for unlocking the piston. The thus modified cycle may be used in an engine with normal axial arrangement as well as in a motor with axial shift, whatever the means employed for effecting the compression, the cycle used, the nature of the fuel and the thermal process or the supply system adopted (carburettor, injection or other).

The method described, further permits a complete evacuation of the burnt gases, due to the absence of a compression chamber or dead space.

The ignition, at any required point of the motor stroke of the engine piston, without corresponding loss in the ratio of compression, may be obtained by a suitable mutual adjustment of compressor and engine, for instance by keying suitably the first with respect to the second.

HENRI LEOPOLD JAVAL.

PUBLISHED
JUNE 1, 1943.
BY A. P. C.

H. L. JAVAL
EXPLOSION AND INTERNAL COMBUSTION ENGINES
Filed Oct. 7, 1941

Serial No.
414,028

Fig. 1

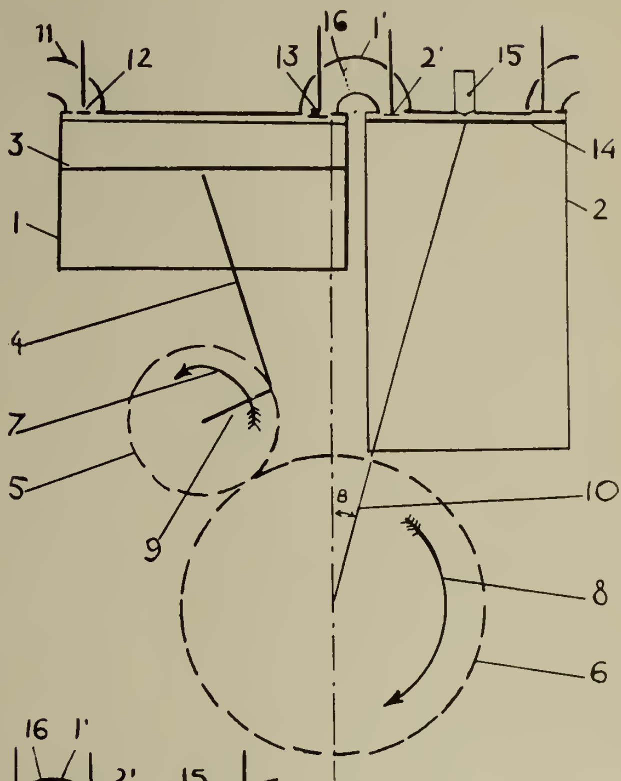
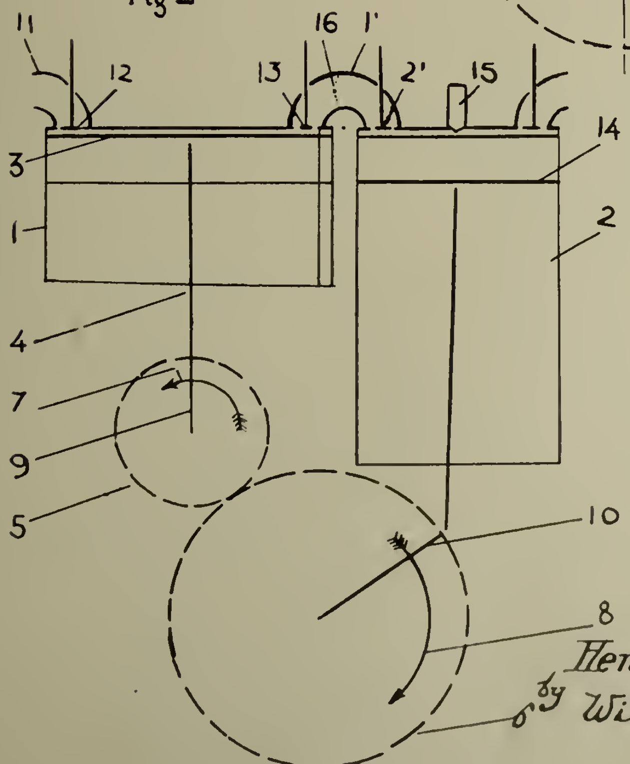


Fig 2



Inventor
Henri L. Javal
by Wilkinson & Mawhinney
Attorneys.

Published June 1, 1943 Serial No. 414,040

ALIEN PROPERTY CUSTODIAN

CRYSTALLIZERS

Isak Isaachsen, Oslo, Norway; vested in the Alien Property Custodian

Application filed October 7, 1941

The present invention has for its object a crystallization apparatus of the type in which a solution is maintained in circulation by means of a pump through a crystallization vessel with a free level of liquid, through supersaturation means outside of the crystallization vessel and then in a supersaturated condition back into the crystallization chamber through a pipe downward to a point below a body of crystals in said chamber and thereupon in an upward direction through the said body of crystals.

As compared with known crystallizers of this type an important feature of the apparatus which is the object of the present invention consists therein that certain parts of the apparatus are arranged at such a level in relation to the free level of liquid in the crystallization chamber as to enable a reduced pressure to be maintained therein.

In the accompanying drawing, Fig. 1 is a diagrammatic sectional view of a crystallization apparatus of the known type outlined above. Fig. 2 is a diagrammatic sectional view of a crystallizer according to the invention.

Fig. 3 illustrates a modified arrangement.

By the use of the known type of crystallization apparatus as illustrated in Fig. 1, the operation is about as follows:

A body of crystals 1 is maintained in the suspension by forcing by means of a pump 2 a solution of the same substances as that of the crystals through some contrivance adapted to bring about a metastable supersaturation in the solution, such as for example a cooler 3, then through a horizontal connection pipe 4 and a tube 5 and therefrom up through the body of crystals 1 and back to the pump through the suction opening 6.

The present invention is based on the discovery that several important advantages can be attained by a modified arrangement, which has not previously been made use of, because at first glance it would seem to be only an unnecessary complication.

It is a characteristic feature of this arrangement that the pump is placed at such a height as will produce a partial vacuum in the same.

Another important feature of the arrangement consists therein that the cross section of the suction pipe at the inlet thereof below the level of the liquid has a substantially horizontal position.

Figures 2 and 3 of the drawing illustrate two different embodiments of the invention.

The crystallizers according to the invention are operated in substantially the same manner as the known crystallizer illustrated in Fig. 1, but the arrangement—as will be seen—differs therein that the suction pipe of the pump is passed up to above the surface of the liquid, as well as therein that the cross section of said pipe at its inlet opening 7 is not vertically, but horizontally disposed. Further the connection pipe 8, Fig. 2, between the cooler 3 and the pipe 5 is also situated above the level of liquid in the suspension vessel 9.

Obviously considerable drawbacks are involved by the necessity of operating at a reduced pressure (partial vacuum) in the centrifugal pump 2.

The arrangement involves the risk of air being sucked into the liquid at untight points; and in addition auxiliary air suction devices for use when starting the operation are necessary. These obvious inconveniences have hindered the experts from recognizing the below specified advantages attainable by the arrangement according to the invention. These advantages greatly outweigh the inconveniences involved:

I. The cross section area 7 of suction intake need not be situated much higher above the upper boundary 10 of the crystal suspension than the bottom edge of the vertical suction inlet opening 6 illustrated in Fig. 1, where the locally greater velocities of liquid cause small crystals to be drawn up from the suspension surface 10. The suspension vessel therefore already for this reason can be built approximately so much lower as what corresponds to the diameter of the suction opening 6 of Fig. 1.

II. The horizontal edge of the suction inlet 7 will cause no whirls about a vertical axis to be produced, and is much less capable of sucking air down from the surface of the liquid than is the opening in Fig. 1, which has a strong tendency in this respect. Also for this reason, therefore, it will be possible to keep the liquid at a substantially lower level, and this again means a saving in the height of the suspension vessel. Such reduction in height does not only involve a direct saving in cost in view of the expensiveness of the material of which the suspension vessel must frequently be made when corrosive liquids are treated, but there is involved also an indirect saving in plant and manufacturing costs, because smaller quantities of liquid are needed to fill the apparatus. In addition smaller containers are needed for temporary storage of the liquid during operation pauses for cleaning or repair of the apparatus.

What has been said with relation to an apparatus with cooler is pertinent also in connection

with apparatus with other means for creating supersaturation, for example by means of evaporation under vacuum or by a chemical process.

III. The circulating liquid frequently has a tendency to form coatings in the cooler pipes, so that it is of great importance to be able to cleanse these pipes without long lasting interruption of operation. By the arrangement hitherto known this has not been the case, because the cooler through pipe **4** (Fig. 1) and the suction pipe **6** of the pump communicated with the liquid in the suspension vessel. It would be necessary either to draw out large quantities of solution from the suspension vessel in order to have the cooler completely or partly emptied, or stop valves would have to be inserted in the pipes **4** and **6**. Apart from the increased cost, this latter arrangement would be undesirable in view of the supersaturated solution which has to be employed in all crystallizers, because such valves lead to the formation of dead spaces wherein small crystals may be retained, grow and cause obstructions.

When using applicant's arrangement according to Fig. 2, one needs only, after shutting down the pump **2**, to let air into pipe **5** through the cock **11** in order to lower the surface of liquid in the cooler **3** to the extent that the upper end of the pipes becomes visible. It is usually at this end of the pipes that the greatest risk of coatings being formed is experienced. It is then also easy to cleanse the pipes and to control the cleansing operation.

Further, if air is also let into pump **2** by means of a cock **12**, it is possible when required to withdraw the solution from the cooler **3**, without it being necessary to draw off liquid from the suspension vessel **9**.

Fig. 3 of the drawing illustrates by way of another example how the advantages mentioned under point III may be attained with still greater perfection than by the arrangement of Fig. 2.

In order that a complete cleansing can be performed without interruption of the operation, two coolers **13** and **14** are arranged, of which one may be in operation while the other one is cut out.

By the arrangement of the pump above the level of liquid, the necessity of inserting stop valves in the circulating pipes is avoided. From the pump **2** the liquid may be forced either through pipe **15** and cooler **13** or through pipe **18** and cooler **14**, or also through both coolers in parallel.

Cutting out one of the coolers is simply done by opening the air cock **19** or **20** respectively of the cooler in question. If, for example, the air cock **20** is opened, the solution in the cooler **14** and pipe **18** sinks right down to the level of the liquid in container **8** plus a height which corresponds to the resistance caused by the pump continuing to force liquid through pipe **15**, cooler **13**, pipe **3** and suspension **1**. Through the cooler **14** nothing passes, because the liquid in pipe **18** does not rise high enough to reach the upper end of the cooler.

An arrangement according to Fig. 2 as well as one according to Fig. 3 is contingent upon a contrivance being available for sucking air out through the air cocks, when the circulation is to be started.

ISAK ISAACHSEN.

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I. ISAACHSEN
CRYSTALLIZERS
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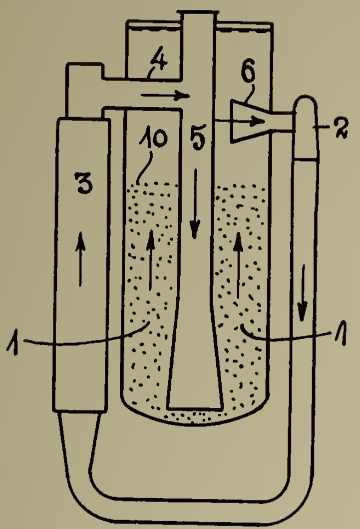

Fig. 1.

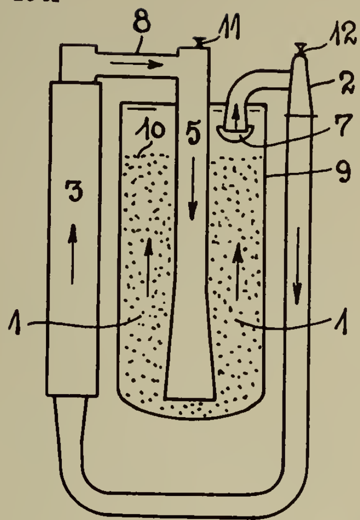

Fig. 2.

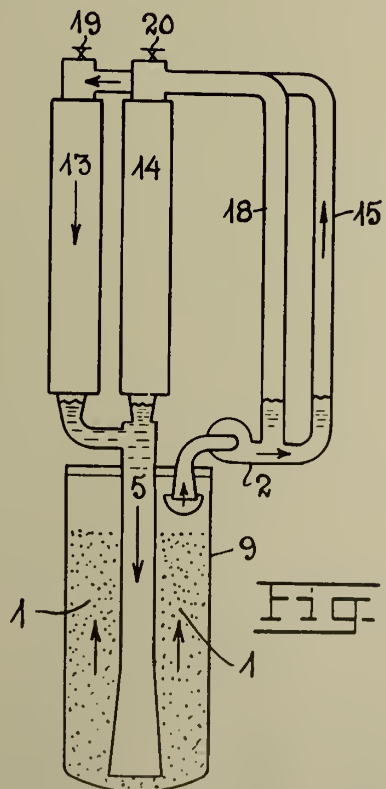

Fig. 3.

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ALIEN PROPERTY CUSTODIAN

PROCESS OF MANUFACTURING COMPOSITE METAL BODIES

Ernst Meier, senior, Braunschweig, Germany; vested in the Alien Property Custodian

Application filed October 8, 1941

My invention relates to improvements in the process of manufacturing composite metal bodies, and more particularly in the process in which molten metal is sprayed onto a solid body for coating the same, and the object of the improvements is to provide a process by means of which the sprayed metal is intimately bound to the body of solid metal.

It has heretofore been proposed for preventing oxidation of the metal being sprayed on the metal body by a current of a gaseous fluid, to use an inert gas such as nitrogen for carrying the molten drops of metal onto the surface, or to spray the metal together with a deoxidizing medium which is molten together with the metal and provides a protecting coating for the drops being sprayed. I have found that by this method oxidation of the surface of the solid body of metal is not prevented, because in case of inert gas being used as a protecting medium the said gas does not protect all the parts of the basic body from the oxygen of the air, and, in case of a molten deoxidizing medium being used, by reason of their higher gravity, the metal drops remove the deoxidizing medium from the surface of the basic body by their impact.

The object of the improvements is to provide a process in which oxidation of the surface of the basic body is prevented, and with this object in view my invention consists in applying the deoxidizing medium to the surface of the basic body prior to spraying the metal or metal alloy onto the same, and after spraying subjecting the basic body and the metal sprayed thereon to heat treatment for intimately binding the coating to the basic body.

For the purpose of explaining the invention apparatus for carrying out the process has been shown in the accompanying drawing, in which

Fig. 1 is a perspective view showing a metal spraying apparatus and a basic body to be coated,

Fig. 2 is a sectional elevation showing an apparatus showing the basic body with the coating applied thereto and apparatus for subjecting the same to heat treatment, and

Fig. 3 is an elevation illustrating the cooling of the combined metal body.

For the purpose of explaining the invention I have illustrated the same as embodied in a process for lining a bush with lead bronze. But I wish it to be understood that my invention may be used for applying a coating of a metal or metal alloy to various basic bodies such for example as gear wheels, valve plugs, multi-layer bearings, etc. By my improved process the coating metal is intimately bound to the basic body and therefore I am enabled to apply the coating in exceedingly thin layers to the whole surface of the basic body or a part thereof. For example, in case of gear wheels it will frequently be sufficient to apply the coating only to the surfaces of the teeth.

The basic body may be made from iron, steel, and other metal. The coating metal, such for example as lead bronze, may be applied by means of the well-known spraying gun, and it may be a meal or an alloy in the form of a rod, wire, or powder.

Referring now to Fig. 1, the letter *a* indicates the basic body in the form of a bush, the said basic body being placed on a suitable support *c*. Near the said support, a metal spraying device *g* is located, which may have any known or preferred construction. The details of the said spraying apparatus, such as the means for heating the metal, feeding means for the metal and means for producing a blast of air or another gaseous fluid are known in the art, and I deem it not necessary to describe the same in detail.

Before the metal is sprayed onto the surface of the body *a* to be coated, a suitable deoxidizing medium such as borax is applied to the said surface, whereupon spraying begins.

After the desired thickness of metal has been applied the basic body with the coating applied thereto is embedded all around in a body of sand *d* confined in a box of iron *e*, as is shown in Fig. 2, and the said body is brought into a fire place *f* for being heated therein. To prevent oxidation of the metal the sand may have a deoxidizing medium such as char coal powder admixed thereto. The body is heated for a suitable length of time depending on the thickness of the body and the desired diffusion of the metal at a temperature of from 900 to 1000° C. According to various conditions such heating may be extended to from 1½ to 10 hours.

I have found that it is sufficient to heat a bush having a thickness of 5 millimeters for about 1 hour at a temperature of from 900 to 1000° C. By such subsequent heating the metal coating diffuses into the basic body, whereby it is intimately bound thereto.

After the said subsequent heating the body is taken from the box and placed on a suitable support for being cooled by means of cooling water sprayed thereon by means of a nozzle *h*.

In my improved process the deoxidizing medium prevents oxidation of the basic body as well as the sprayed metal drops, and it reduces any oxidized metal which may be present. In the heating treatment following the spraying of the metal the deoxidizing medium has the function to prevent oxidation of the basic body or to reduce oxidized metal.

ERNST MEIER, Sr.

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JUNE 1, 1943.

BY A. P. C.

E. MEIER, SR

PROCESS OF MANUFACTURING
COMPOSITE METAL BODIES

Filed Oct. 8, 1941

Serial No.
414,206

Fig.1

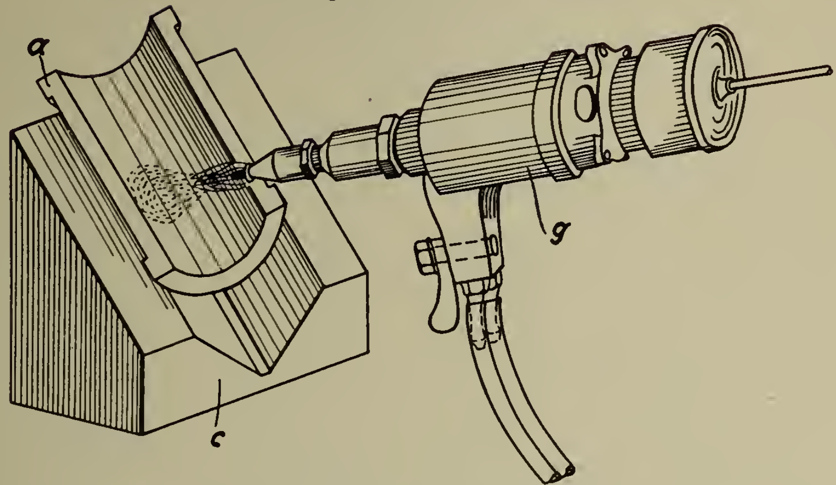


Fig.2

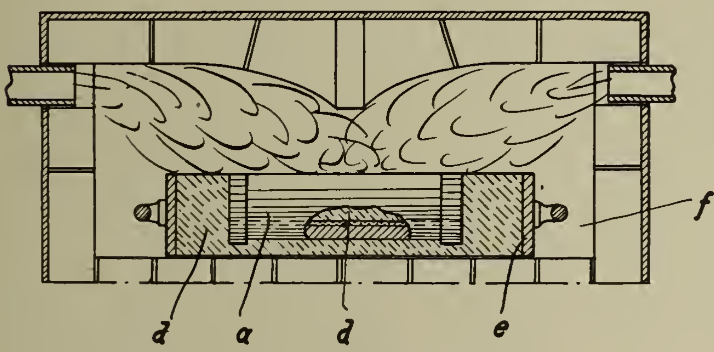
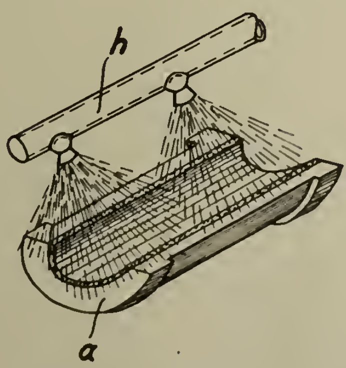


Fig.3



INVENTOR

Ernst Meier, Sr.

By

ATTORNEY

Published June 1, 1943

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ALIEN PROPERTY CUSTODIAN

METHOD OF APPLYING BUSH METAL TO BUSHES

Ernst Meier, senior, Braunschweig, Germany; vested in the Alien Property Custodian

Application filed October 8, 1941

My invention relates to improvements in the method of applying bush metal to bushes, and particularly in the method in which a solid body of bearing metal such as white metal, red brass, lead bronze and the like is placed within the bush and heated while the said bush is rapidly rotated, the metal being molten and thrown into contact with the inner surface of the bush by centrifugal action. The object of the improvements is to provide a method by means of which the bush metal is safely bound to the inner surface of the bush even if the bush has a great length, and with this object in view my invention consists in placing the said solid body of bush metal within the bush, rapidly rotating the bush, and gradually heating the same and the metal from one end of the bush to the other. Preferably the molten metal is cooled immediately after having been bound to the surface of the bush.

For the purpose of explaining the invention an apparatus for carrying out the method has been shown in the accompanying drawing, in which the same reference characters have been used in all the views to indicate corresponding parts. In said drawing

Fig. 1 is a diagrammatical elevation partly in section showing an elongated bush having the body of bush metal placed therein and rotatably supported on a suitable machine, heating and cooling means, and means for shifting the said heating and cooling means longitudinally of the bush,

Fig. 2 is a sectional elevation taken on the line **2—2** of Fig. 1,

Fig. 3 is a sectional elevation showing a modification of the heating means, and

Fig. 4 is a detail sectional elevation showing a modified form of the body of bush metal.

Referring at first to the elevation shown in Figs. 1 and 2, the blank such as an elongated bush **1** is placed between heads **2, 2** which are mounted respectively on a spindle **3** and a center **4**, suitable means being provided for rapidly rotating the heads **2, 2** and the blank **1**. As shown such means consist of belt pulleys **5**. Within the blank **1** there is a body of bush metal **6** which extends all over the length of the blank **1**, and which may consist of a solid body made by pressing, drawing or casting, or of chips or powder of metal bound together in a suitable way for example by means of a suitable binding medium which may be readily molten or decomposed by heat. In the example shown in the figure the metal **6** is in the form of a solid rod. But I wish it to be understood that my invention is not limited to this feature, and that in some cases I provide the bush metal in tubular form, according to the diameter of the bush and the thickness of the coating to be applied thereto. This modification has been shown in Fig. 3.

Externally of the bush **1** there are burners **7** which are adapted to direct a flame all around the bush **1** for heating the same so far that the bush metal **6** is locally molten, and means are provided for gradually moving the said burner from one end of the bush to the other one, so that the bush metal **6** is molten in succession. As shown the burners are mounted on a bracket **8** rising from a slide **9** mounted on the bed **10** of the machine and engaged by a screw-threaded spindle **11**. Fuel is supplied to the burners by a hose **12**. By the rapid rotation of the blank **1** the molten metal is thrown on the inner wall of the bush **1**. As the burner **7** is shifted longitudinally of the bush **1** the molten metal is cooled, so that it is bound to the inner surface of the blank **1**. Preferably a cooling medium is applied to the bush **1** following the burner **7** so that solidification of the metal is accelerated. As shown a spraying device **13** is provided for this purpose by means of which cooling water is sprayed on the outer surface of the bush **1**. The said spraying device is mounted on an arm **14** fixed to the bracket **8**.

Where the body of metal **6** consists of powder or chips of metal a suitable binding medium such as waterglass or glue is preferably admixed thereto. But I wish it to be understood that my invention is not limited to the use of a binding medium and that the powder or chips of metal may be bound into a coherent body by high pressure or in another way. Further, I may provide a deoxidizing medium such as borax, which is particularly desirable where the metal powder or chips are partly oxidized. Where the body **5** is built up from powder or chips I admix the deoxidizing medium thereto, and where it is in the form of a solid rod or pipe made by casting, pressing or drawing I apply the deoxidizing medium to the outer surface of the rod. Preferably where the bush metal is in the form of a tubular body such as is shown in Fig. 3 at **15**, the deoxidizing medium is also applied to the inner surface thereof. When the bush metal is being heated and molten the deoxidizing medium reacts with the oxide of the bush metal, whereby additional heat is produced which accelerates the melting of the metal.

As appears from Fig. 1, the metal **6** is gradually molten as the burner **7** advances from the right

to the left, and it is thrown into contact with the inner surface of the bush 1 and subsequently solidified so as to be bound to the bush, solidification being preferably assisted by the cooling liquid supplied by means of the sprayer 13. Fig. 2 shows the bush metal partly molten and applied to the surface while another part of the metal is still solid.

In the modification shown in Fig. 3 a burner has been shown which consists of a hollow ring 16 having a supply of fuel through a hose 17 and formed internally with nozzles or bores 18 for the delivery of the fuel therethrough.

While in the figures burners 2 have been shown for heating the blank, I wish it to be understood that my invention is not limited to such heating means, and that other heating means may be provided, for example heating means based on the use of high frequency electric current.

While the metal is being molten the outer air is excluded by tightly fitting the blank between the heads 1, 1, so that oxidation of the metal is reduced to a minimum. Therefore the bush metal is intimately bound to the bush 4.

The velocity of the movement of the burner 2 and the sprayer 3 depends on the thickness of the wall of the blank 4 and on the time required for melting the bush metal.

ERNST MEIER, Sr.

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E. MEIER, SR

METHOD OF APPLYING BUSH METAL TO BUSHES

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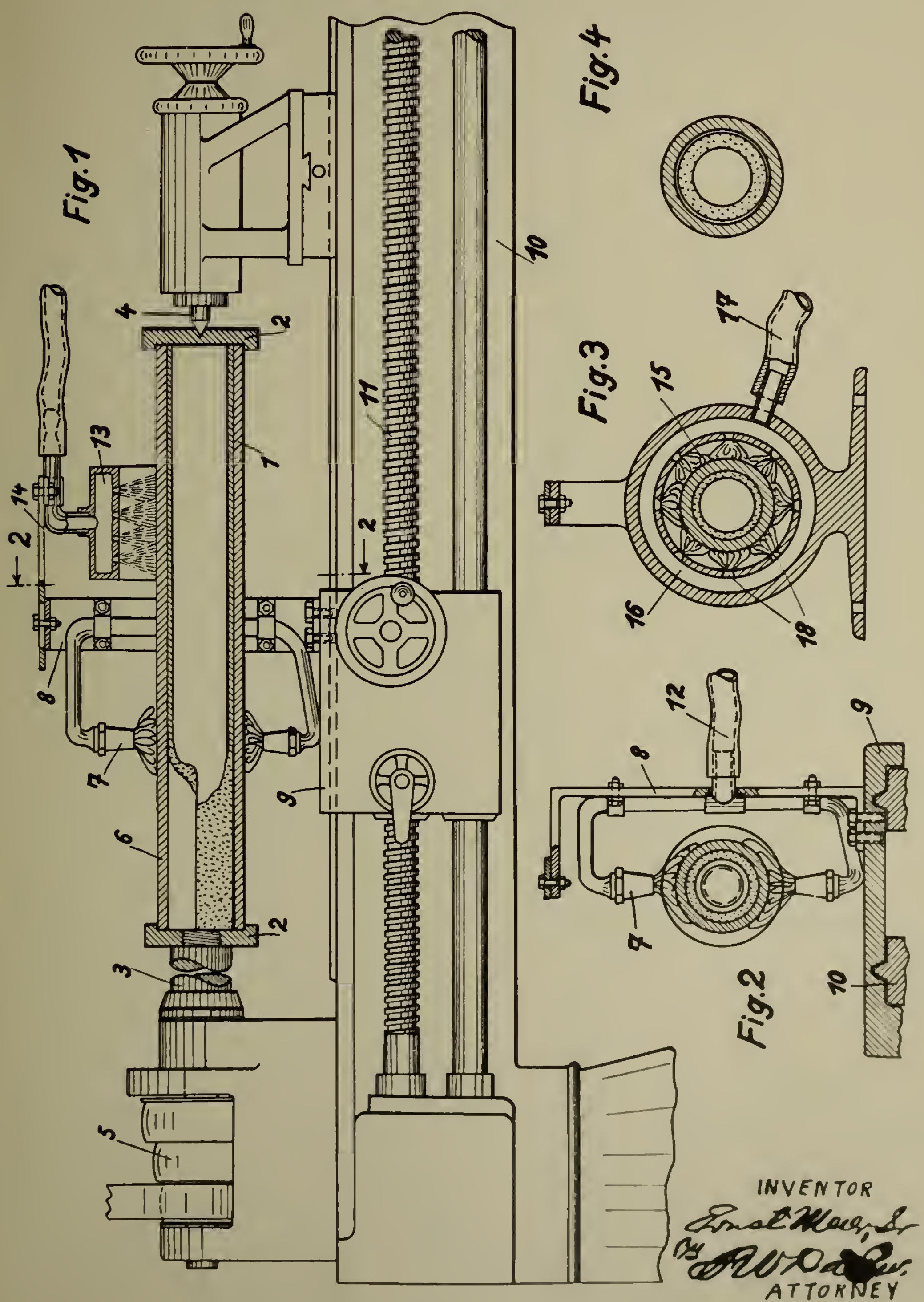

Published June 1, 1943

Serial No. 415,056

ALIEN PROPERTY CUSTODIAN

DEVICE FOR CLAMPING A MEMBER TO A SHAFT

Marius Piot, Roanne, France; vested in the Alien Property Custodian

Application filed October 15, 1941

Heretofore pinions, pulleys, cams, levers or similar members comprising a bored or ring-shaped part have been generally clamped to their supporting shaft by means of one or several keys or feathers. Such clamping means is defective in numerous instances, particularly in the case of machines whose power or efficiency undergoes large variations because members keyed to the shaft rapidly wear away owing to the frequent reactional strains due to power fluctuations, so that after a relatively short period of time due to repeated shocks or jerks, such members become loose upon the shaft, their bore becoming oval while the keyway grows to a state of distortion. Moreover, the outset of the wear does not appear early enough to permit such distortion being precluded so that the shaft and pinion or other member carried thereby rapidly become unfit for further operation and must be discarded. The substitution of new parts entails considerable expense both in material and in time. This occurs particularly in the typical case of pinions such as those mounted on shafts associated with motors utilised for individually driving looms, compressors and other machines whose efficiency chart line has a sawtooth or jagged outline.

An object of the present invention is to provide an improved device for clamping a member such as a pinion, pulley, cam, eccentric, lever, link, sleeve or the like (hereafter called "member" to a shaft, axle or arbor (hereafter called "shaft") which avoiding the aforesaid disadvantages particularly in case of machines or apparatus whose efficiency or kinetic output undergoes large operational variations or fluctuations.

Another object of the invention is to provide a device for clamping a member as aforesaid to any convenient part of a supporting shaft (whether driving or driven), said device being also applicable to the elastic coupling end to end of a pair of co-related shafts and enabling an offsetting of said shafts where required.

Another object of the invention is to provide a device for so clamping a shaft to a member having a hollow boss, hub or other bored part encompassing said shaft as to set up proper diametrical thrusts for adequately transferring from the one to the other the stresses which must be transmitted.

Another object of the invention is to provide a device for clamping a member to a shaft by resilient means and under such conditions as to automatically and permanently preserve that minimum degree of compression on said resilient means which is required for interlocking them and enabling proper power transmission.

Still another object of the invention is to provide a device ensuring a very steady and stable clamping of the member on the shaft or like carrier and while at the same time absorbing shocks, jerks or jogs and the concomitant causes of wear and tear on the parts that are clamped together.

A further object of the invention is to provide a device for securely clamping a member to a shaft without requiring keys, feathers or pins, whereby shafts or hubs of smaller cross sectional area may be used without impairing reliability of transmission, while lessening unit pressures on the shaft and member due to adequate distribution of the total pressure throughout their matched surfaces.

With these and such other objects in view as will incidentally appear hereinafter, the invention comprises the novel construction, combination and arrangement of parts that will now be more fully described with reference to the accompanying diagrammatic drawing exemplifying embodiments of the same and forming a part of the present disclosure.

In the drawing:

Figure 1 is a longitudinal sectional view of a first embodiment of the invention as applied to the clamping of a pulley to the screw-threaded end of a shaft engaged therethrough, the clamping being performed by means of a sleeve and a pair of nut-pressed washers.

Figure 2 is a view somewhat similar to Fig. 1 (the screw thread being omitted for the sake of clearness) showing diagrammatically by arrows the directions of the forces exerting themselves on the washers and on the shaft and member through the plastic sleeve interposed therebetween.

Figure 3 is a longitudinal sectional view on the line **3—3** of Fig. 4 showing another embodiment of the invention as applied to the clamping of a pinion or cogged wheel to the end of a shaft.

Figure 4 is a cross sectional view on the line **4—4** of Fig. 3.

Like reference numerals designate like parts throughout the several views.

Reference being first had to Fig. 1, it will be seen that the device according to the invention is intended to clamp a hollow ring-shaped member such as a pulley or block **1** to the reduced end **2*a*** of a supporting shaft **2** which may be either a driving or a driven shaft. The free extremity of the reduced end **2*a*** of this shaft is screw-threaded

as at $2b$. A pair of washers 3, $3a$ are fitted over the reduced end $2a$ of the shaft, and a nut 4 is engaged over the screw-threaded extremity. The clearance or free space between the inner surface of the pulley 1 and the reduced end $2a$ of the shaft 2 is filled up by a solid sleeve or annular interponent 5 made of a plastic, yielding and resilient substance such as rubber or a rubberized or equivalently endowed stuff. As will be seen, in operative position, the plastic sleeve 5 is interposed between the washers 3, $3a$ and can be imparted any requisite degree of compression by screwing up the nut 4.

As will be understood from an inspection of Figs. 1 and 2, when the nut 4 is screwed up, as the left hand side washer 3 is firmly held in position by abutting against the shoulder $2c$ formed at the outset of the reduced portion $2a$ of the shaft 2, the plastic sleeve 5 is compressed between the two washers, whence it receives (as illustrated by the arrows *a, a, b, b*) bilateral pressures the result of which is to distort said sleeve, i. e. to increase its diametrical size while decreasing its longitudinal size. This distortion or "swelling" of the plastic sleeve or interponent 5 gives rise to a diametrical thrust both inwardly on the shaft (as shown by the arrows *c, c*) and outwardly on the inner face of the pulley (as shown by the arrows *d, d*).

Such thrust increases when the nut 4 (Fig. 1) is further screwed up and the washers 3, $3a$ are tightened to a greater extent. The intensity of this thrust exerting itself both inwardly and outwardly is sufficient for ensuring such an adhesion as to firmly clamp together the shaft and pulley while preserving their matched surfaces from wear since any mutual friction or attrition thereof is precluded by the presence of the interponent 5 which also acts as a protective lining. As will be understood, the compression of the resilient substance of which the interponent 5 is made performs a permanent self-locking effect so that interdrive between the shaft and pulley or equivalent member (such as another shaft in case of line shafting) is properly ensured.

As the shaft 2 rotates in the direction shown by the arrow *f* in Fig. 1, it will be understood that owing to the resiliency of the plastic sleeve 5 and the resisting to the driving action, there occurs a certain amount of lag between the shaft and the driven member 1 and consequently an instantaneous partial drive of the nut 4 since its driving torque by the plastic sleeve 5 and the washers 3, $3a$ is always larger than the negative torque exerted by the screw threads.

Reference being now had to Figs. 3 and 4, it will be seen that there is shown in them a modification of the device applicable to constructions in which the dismantling of a member removably fitted to the end of a shaft has to be effected easily and quickly as for example when said member is a pinion or a cogged wheel such as 14 adapted to be revolved by a driving shaft 2 having a reduced end $2a$ defining a shoulder $2c$.

This constructional modification of the device includes in combination with the plastic or resilient sleeve 5 a slotted bushing 6 preferably made of soft steel or equivalent metal or alloy and having a length smaller than that of said sleeve. The bushing 6 is interposed between the sleeve 5 and the reduced end $2a$ of the shaft 2. Instead of being externally screw-threaded as shown as $2b$ in the form illustrated in Figs. 1 and 2, the reduced end $2a$ of the shaft is internally bored and tapped as shown at $2d$ to receive the shank of a screw 13 whose head presses the adjacent washer $3a$ against the side face of the plastic sleeve 5.

It will be understood that by tightening up the screw 13, the pressure exerted thereby is communicated through the adjacent washer $3a$. This squeezes lengthwise the plastic sleeve 5 whose remote side face is clamped against the oppositely disposed washer 3 while radially swelling said sleeve against the metallic bushing 6 and against the inner face of the pinion or other member 14. By adequately tightening up the screw 13, the pressure thus exerted by the plastic sleeve 5 against the bushing 6 and pinion 14 may be rendered large enough to provide such a perfect adhesion and interlocking as to ensure a strong and steady interdrive between the driving shaft 2 and the driven pinion 14. At the same time, owing to its plastic or resilient character, the interponent or sleeve 5 absorbs shocks or jerks and lessens reactional or back lash stresses and protects the shaft and pinion from undue wear or breakage. Self-locking is obtained as in the constructional form shown in Figs. 1 and 2.

It will be understood that the invention is not restricted to the constructional forms shown and described by way of non-limitative examples. Thus for example the plastic or resilient sleeve may be formed in one piece or in several pieces and its shape may differ from that of a cylindrical annulus. All such variations are included in the ambit of the word "interponent" used in the subjoined claims whose scope should be construed in a broad sense.

MARIUS PIOT.

PUBLISHED JUNE 1, 1943. BY A. P. C.

M. PIOT

DEVICE FOR CLAMPING A MEMBER TO A SHAFT

Filed Oct. 15, 1941

Serial No. 415,056

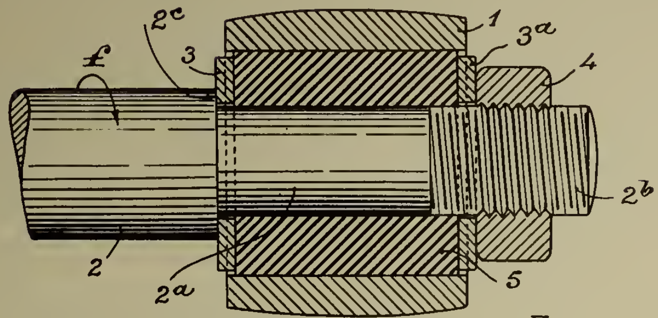

Fig. 1

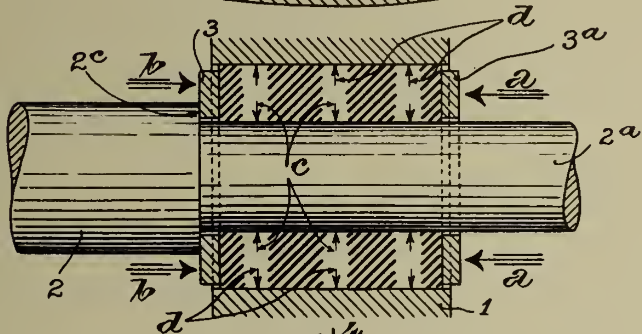

Fig. 2

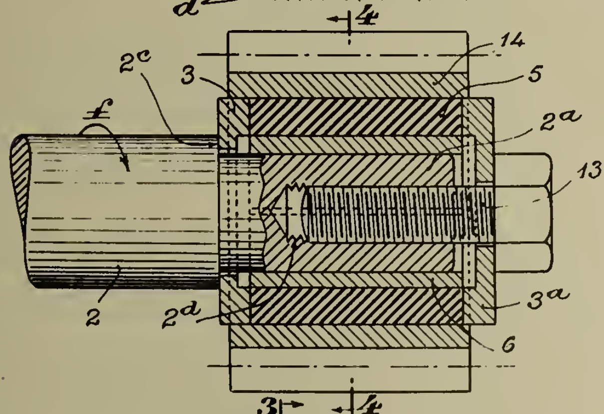

Fig. 3

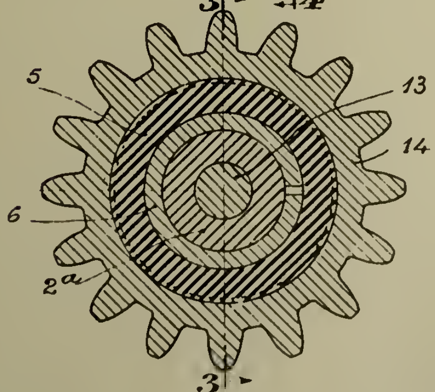

Fig. 4

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Published June 1, 1943

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ALIEN PROPERTY CUSTODIAN

RURAL STOVE

Marius Carol, Nay (Basses-Pyrenees), France; vested in the Alien Property Custodian

Application filed October 21, 1941

In the country, till now, people use most often, for the cooking of food, a hearth with visible fire, placed in a big chimney, using, or not, firedogs; pans or pots are put on a trivet standing in the fireplace or hanging at a pot-hanger.

If such a stove of an extreme simplicity allows to burn branches and logs as they come from the faggots, it has on the other side some inconveniences.

It is difficult to warm simultaneously several recipients, in an appropriate way; the calorific produce is very small; there is no regulating means; the housekeeper has at her disposal neither oven nor any means to produce hot water; etc. it is the reason why, in many dwellings, people use, supplementarly, a heating-apparatus called a "Dutch-oven". However, this apparatus is seldom used: it wants coals, or at least, wood cut in small pieces; it warms the room in an excessive way during summer; besides, its fire is not visible, which breaks country-practices.

The object of this invention is a rural stove which ensures, by itself, in the best conditions, all calorific services the country-people may wish, as regards utility as well as comfort. This stove consists essentially in two boxes that are placed in existing chimneys and are separated one from the other by a certain interval. The two boxes are destined, on the one hand, to act as firedogs would do, but instead of being a simple support for the wood, as ordinary firedogs, they are, on the other hand, able to be employed as ovens, or, simultaneously, by their upper side, for the heating of recipients in the same way as dish-warmers.

Most easily, the heating of these boxes results of calorific conductibility, the parts which support directly the ignited fuel transmitting the heat to the whole wall, and that by radiation.

In a more improved realization, the boxes are provided with double walls, so that a part of gas issuing from the combustion circulates inside of the interval formed by this double wall before going to the chimney. The heating-circuits for the two boxes may, according to the case, be disposed serially or parallelly.

In order to insure a good circulation of these gases, it is intended to heat, on a certain length, their exhaust pipe in the chimney by means of gas issued directly from the hearth. On the same purpose, a part of the wall of this exhaust pipe is formed by the guard-plate itself, that is to say the plate which lengthens the backside of the boxes. Besides, the said pipe is advantageously surrounded by the eduction pipe of the gas issuing directly from the fireplace, and the gases which have circulated in the interval limited by the double wall of the boxes are mechanically carried along by those issuing directly from the hearth, owing to an exhauster effect.

Preferentially, the interval between the two boxes is made in order to be able to constitute a small self-acting hearth for wood or coal, able to be used, for instance, when a single recipient is to be heated. It is then provided with plates in order to obtain a closed hearth.

In the following, it will be described, by way of example, a realization of a rural stove according to the invention. In the annexed drawing:

Fig. 1 is a front view;

Fig. 2 is a plan view;

Fig. 3 is a side-view;

Fig. 4 is a sectional view, in greater scale, according to line 4—4 of Fig. 2;

Fig. 5 shows, in section, the gas exhaust pipes, next the spot where the exhaust pipe, after warming the boxes, opens out on the exhaust pipe of gas issuing directly from the hearth.

The rural stove according to the invention includes two boxes A and B, leaving between them a certain interval C. The backsides 1 and 2 of these boxes lengthen by a common guard-plate 3; the opposite sides 4 and 5 are, in their upper part, inclined one towards the other and limits, with the guard-plate 3, a small hearth 6. They wear projections 7 and 8, on which lays the grate 9 of the hearth. Preferentially, the grate 9 does not reign on the whole depth of the boxes A and B, but only on about the backhalf of these. The front half is formed by a fullplate 10. So, a better draught is obtained for the hearth 6. Under the grate 9 and the plate 10 an ash-pit 11 is provided, which lays, with possibility of sliding, on a plate 13 extending the whole length of the apparatus.

The boxes A and B have a double wall. The inside wall 14 of the box B begins on the inclined side 5 of the said box; it shows an upper horizontal part 15, a vertical part 16, and a lower horizontal part 17. It limits, with the outside wall 18 of the box B, (which has an upper horizontal part 19, a vertical part 20, a lower horizontal part 21, a vertical frontside 22, and the backside 2) an interval 23. The interval 23 opens on the hearth 6 by means of openings 24 and 25 (Fig. 2). Ribs 26 and 27 carry the gas coming from openings 24 and 25 on the whole depth of the interval situated between the vertical sides 16 and 20. On the backside 2 there is an opening 28 which can be

closed by a slider 29 which can be operated by means of a handle bar 30.

The box A has also a peripheric interval 31, limited by the backside 1, the frontside 32, the lowerside 33 and a lower horizontal wall 34, an ending vertical side 35, and a vertical wall 36, an upper side 37 and an upper wall 38. The backside 1 has an opening 39. The intervals 23 and 31 communicate together under the plate 13 on the whole depth of the apparatus. Projections 40 and 41 on the plates 34 and 17, are provided for sustaining the plate 13.

The inside of the boxes A and B make ovens 42 and 43 including, if necessary, usual heating plates and grates, and which are closed by doors 44 and 45 provided with handles 46 and 47 (Fig. 1) preferentially insulated against heat. On the inside of the hearth 42 a receptacle 48 is provided for a removable boiler 49, whose side 50, turned towards the hearth, is a part of the wall 4. Tubes 51 and 52 join the boiler to a hot water fitting. On the upper sides 37 and 38 openings are made which are obtured by rings and concentric circles, respectively 53 and 54, the ones fitting in the others, in the usual way, and on which the recipients to be heated are placed.

From the opening 39 is issued an exhaust pipe 55 for the burning gas, and whose foreside 56 is in contact on a very wide surface with the guard-plate 3, or even is a part of the same plate. The foreside of the pipe 55 has preferably waves (not shown for easy reading of the drawing) in order to increase the surface, and which fit, if necessary, with identical waves of the plate 3.

The guard-plate 3 shows, above the hearth 6, an opening 37 which allows the said hearth to communicate to an exhaust pipe 58, surrounding the vertical part of the pipe 55. The walls of this last are, preferentially, corrugated on their part which is surrounded by the pipe 58. The pipe 55 ends at a certain height and so opens in the pipe 58. This latter one shows preferentially, at the outlet of pipe 55, a decrease of its section, as shown in 59, in such a manner that the gas moving in the interval 60 between the two pipes may produce an exhauster effect and carry along, mechanically, the gas contained in the pipe 55. The pipes 55 and 58 are controlled by registers 55^a and 58^a.

A removable door 61 is provided, for instance, on the vertical side 20 of the box B, next to the beginning of the circuit of gas circulating around the ovens 42 and 43.

The guard-plate has one or several turnable supports, (not shown for easy reading of the drawing) which may be used as pot-hangers to suspend some recipients to be heated, and supplying in this way the pot-hangerrack habitually used for the suspension of recipients. However, the pot-hangerrack may also be used.

To use the stove according to the invention, the logs or the branches are placed on the boxes and lighted. A part of gas and flames issuing from the combustion escapes by the aperture 57 towards the pipe 58. Another part of these gases enters into the interval 23, by the openings 24 and 25. In normal conditions, the opening 28 is closed by a slider 29. During its circulation in the interval 23, the gases heat the oven 43 and the upper plate 19. The gases pass then under the ash-pit 11 and reach the interval 31 limited by the double wall on the box A heating so the oven 42 and the upper plate 37. They come out from this interval through the opening 39 where the exhaust pipe 55 opens. The circulation in the double wall of boxes A and B is effectuated, on the one part, by natural draught, and on the other part, in consequence of the heating, on an appreciable height, of the pipe 55, by reason of its contact with guard-plate 3 and of the circulation around the pipe 55 of the gas contained in the pipe 58, lastly by the increase of speed in the narrow section 59, of the gas moving in the interval 60. All these factors are added up and ensure an effectual circulation of the hot gas in the double wall of boxes A and B. The ovens 42 and 43 are used for cooking roast joints, pastry, in the usual way. The upper plates 19 and 37 of the boxes A and B, support the pans, boilers etc. . . . The hot water is permanently at disposal, on account of the presence of the boiler 49.

When just a small fire is required, the hearth 6 is used, built in the interval 6, managed between the boxes A and B. For the open fire heating, if the slider 29 is left shut, the gases get out partly by the opening 57 and the pipe 58, and partly into the intervals 23 and 31. If the slider 29 is open, the gases get out by the opening 57 and the pipe 28 on the one part, and, on the other part, through the pipe 62.

If a closed hearth is required, the invention intends to add an upper plate and a front plate on the hearth 6. If the slider is maintained shut, the stove will then work as a Dutch-oven. If the slider 29 is open, the gas coming from the hearth 6 runs out by the openings 24 and 28 and the pipe 62 which drives them to the pipe 58.

In a preferable structure, the pipe 62 opens out in the pipe 55. In this structure it is easier to joint the pipes 55 and 62 in a single pipe, wide enough at its basis to be able to receive the gas coming from the opening 39, as well as those coming from the opening 28.

When decreasing the radiation of the stove is required, for instance during summertime, the door 61 has to be opened; the intervals 23 and 31 instead of being passed through by hot gas, are then filled with cool air. This cool air comes from the premises which are so ventilated, or from outdoors, by means of an air hole.

The upper sides of the boxes can be covered with an insulating material, in order to decrease also the radiation of the stove. To attain this aim, a brick layer is provided.

Besides, a lengthening of the front sides 32 and 22 of the boxes can be considered with advantage, particularly in order to avoid the falls of the logs laying on the boxes. On the drawing it is shown, for that purpose, two runs 63 and 64 (Fig. 1 to 3), which are, preferentially thermically insulated from the other parts of the apparatus, in order to avoid the burns for the attendants.

When a great amount of hot water is required, supplementary boilers are provided in the inside of the stove or behind the guard-plate, and more particularly next to the pipe 58. The chimney-sweeping is made easy by a trapdoor 65 along the pipe 55.

In the described structure, the heating circuits of the two boxes are disposed in series, that is to say the one after the other. After having run through the interval around the box B, the gases run then through the interval around the box A. In another realization, the invention considers to arrange the two circuits of heating, not in series, but in parallel. The heating of the two ovens becomes so more uniform.

A gas intake of the gas circulating in the canalisation 55 may be used to supply a drying or

an evaporating device etc. . . . The pipe **66** (Fig. 5) is controlled by a hinged shutter; the return pipe is shown in **68**.

In some instances, the fetching of the gas-circulation in the pipe **55** may be obtained by an air ventilator or aspirator. The area of the openings **24** and **25** may advantageously be controlled by a shutter whose opening is, for instance, the result of a traction in the opposite direction to that of the guard-plate. The purpose of this shutter is to let open, in the case of a very small fire, only the part of the openings **24** and **25** corresponding to the hearth and so, to prevent the cold air to come into the heating circuit.

The stove, according to the invention, is normally laid directly on the ground. However, in some cases, it may be better to raise it, by means of feet, or by putting it on a ground work. In this last manner, an opening is managed allowing communication of the ash-pit with a receptacle reserved in the ground work, and whose capacity is sufficient to contain the ashes of several days.

MARIUS CAROL.

PUBLISHED

JUNE 1, 1943.

BY A. P. C.

M. CAROL

RURAL STOVE

Filed Oct. 21, 1941

Serial No.

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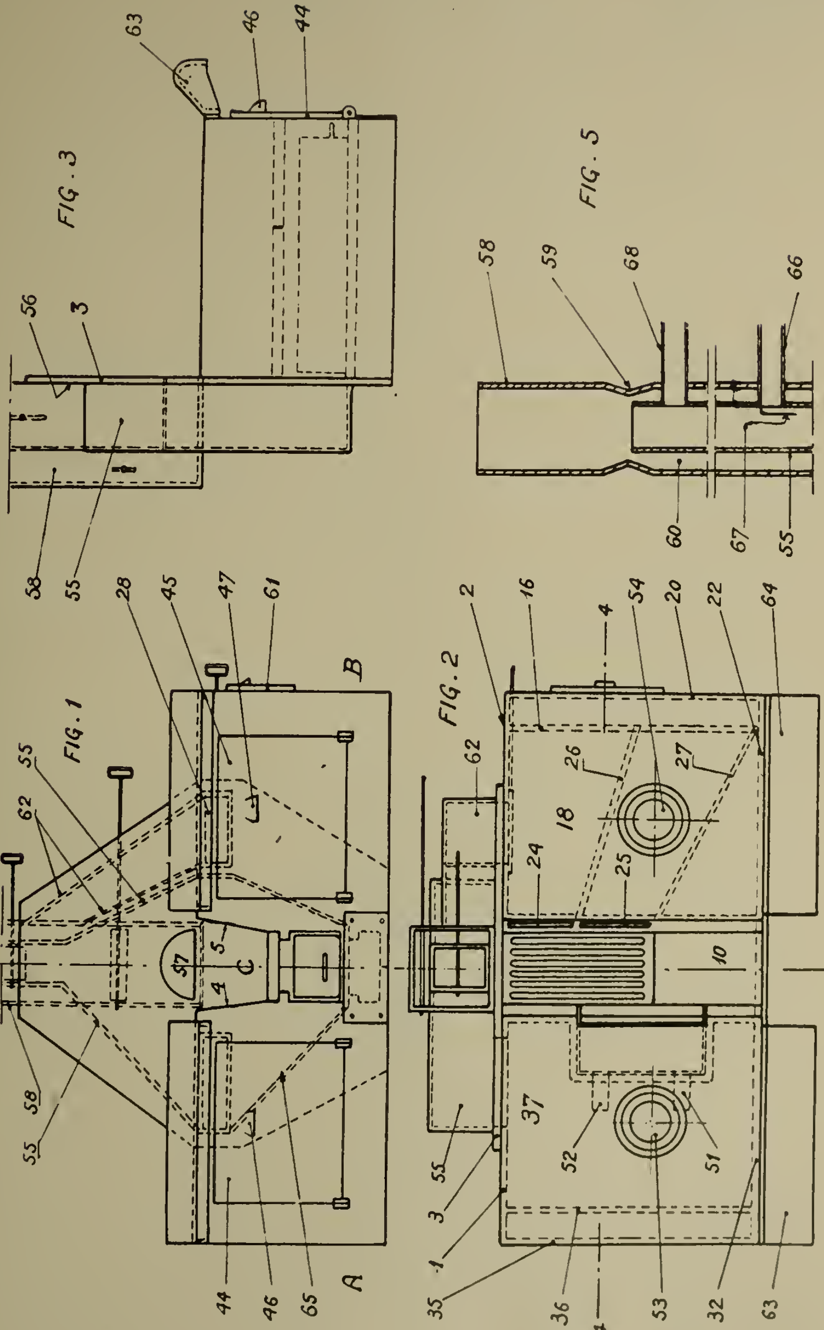

INVENTOR:
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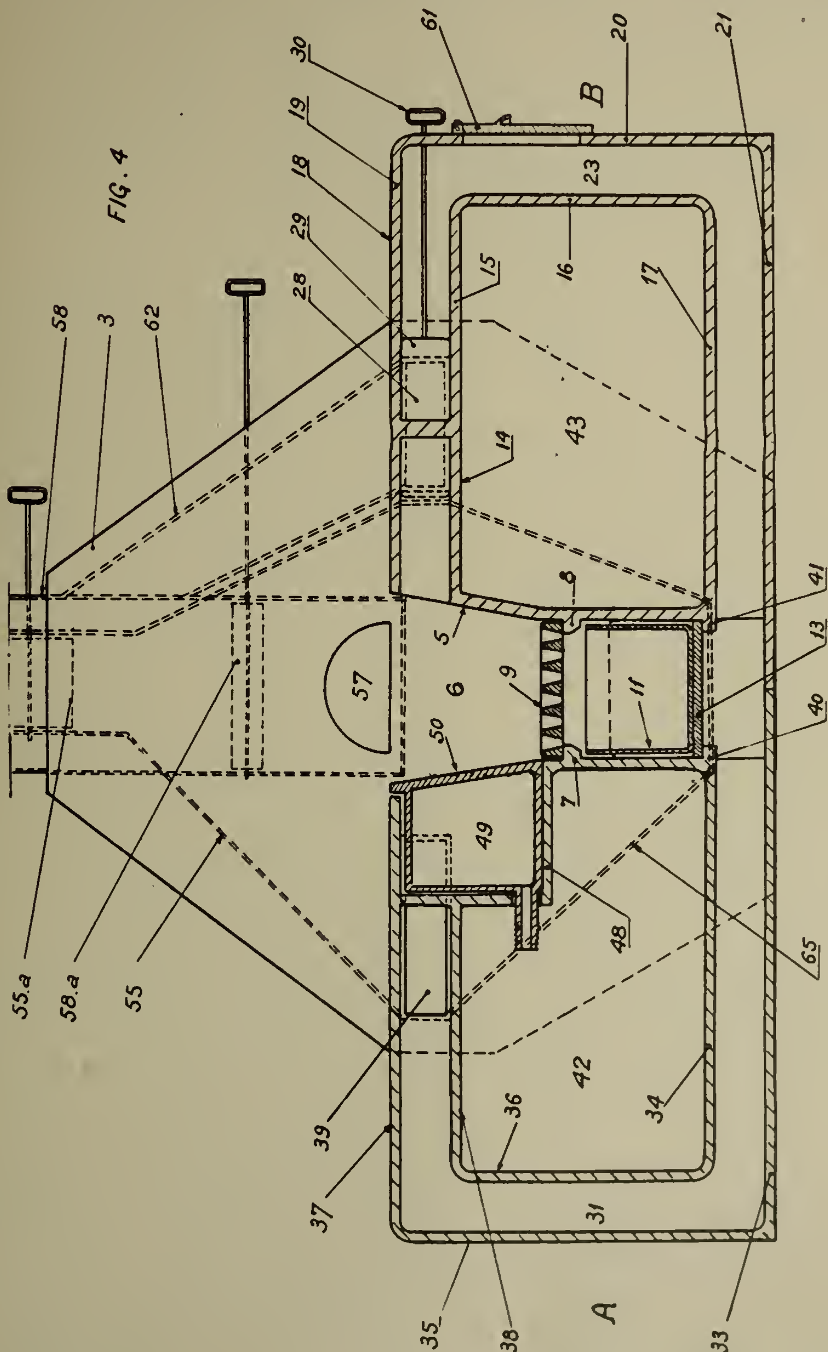
FIG. 4



INVENTOR:
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ALIEN PROPERTY CUSTODIAN

CAST-IRONS AND THEIR MANUFACTURE

Leonce Reygagne, Decazeville, France; vested in the Alien Property Custodian

No Drawing. Application filed October 27, 1941

Blast-furnace mouldable cast-irons such as produced in accordance with iron metallurgy processes, i. e. in apparatus supplied with coke and a blast of hot wind, have a total carbon content which is generally from 3.50 per cent to 4.00 per cent or even more, 0.60 to 1 per cent being in the form of combined carbon. When a cast-iron of the above type is examined with a microscope, free carbon is seen as graphite flakes which are generally voluminous, of variable although always relatively large length, and irregularly distributed.

Up to a recent time, these raw cast-irons were satisfactory as regards the requirements of remelting founders: the mechanical stresses imposed on cast-iron mouldings were but very small, as the metal was considered as a second rate and imperfectible material. But since twenty odd years, it has been found that, contrary to previously admitted theory, it is possible to obtain remelted cast-irons having mechanical characteristics far better than those previously accepted; the considerable improvement in mechanical properties is substantially attributable to the realization of particular structures and, to a minor extent, to that of a determined chemical composition. In case of strong cast-irons, so called steeled or pearlitic cast-irons, which is the most common type, the required structure admittedly consists in permite with free carbon in form of short and thin flakes, as regular as possible in respect of dimensions and distribution; excess ferrite should be prohibited, and the amount of free cementite should be as low as possible. To sum up, according to present conceptions the material should be given a pearlitic steel structure, and the strength towards mechanical stresses should be lowered as little as possible by those components which specifically characterize cast-iron, to wit, free graphite and free cementite. On the contrary the form of the latter components should be such as to highly increase friction strength and to result in the production of defectless mouldings.

It is particularly advisable to remove ferritic stains which are frequently found in cracked pigs. As a matter of fact when such pigs are melted, the mouldings produced therefrom exhibit like stains and many difficulties are experienced in their employment (lowered mechanical strength, liability to seizing under friction, rapid wear and so on).

The remelted, pearlitic, strong cast-irons generally have the following chemical composition:

Total carbon	2.80 to 3.20 per cent
Combined carbon	0.7 to 0.9 per cent
Silicon	much variable according to the dimensions of the piece and the cooling process
Sulphur	as little as possible
Phosphorous	maximum 0.20 per cent, preferably 0.12 per cent

Various methods are known for producing cast-iron shapes having the required micrographic structural characteristics and hence the required mechanical qualities. Amongst these methods, one of them is more and more preferred by founders by reason of its advantages such as its being easily carried out and the value and regularity of the results obtained therefrom. It is the method which consists in melting in a cupola or any other suitable apparatus, charges containing a predetermined proportion of a special fine-grained, raw cast-iron which has a low carbon content; furthermore they generally contain scraps arising from the manufacture of strong moulded pieces. Therefore experienced founders have regularly required such blast-furnace cast-irons with close grains and a low carbon content.

Up to this time, the said cast-irons could be manufactured only in a few blast-furnaces producing haematite mouldable cast-iron and the process differs from the usual process for producing mouldable cast-iron in the following respects:

A particular manner of working in the blast-furnace,

The use of suitable charges,

Or a combination of both.

By reason of the particular operation of the blast-furnace, it is possible to obtain:

1. A relatively low carbon content,

2. A graphite the development of which is controlled.

3. No structural anomalies.

I have now found that the manufacture in the just described conditions may be completed with full success by an after-treatment of cast-iron.

The latter treatment has for an object, in addition, to adjusting, as is always desirable, the proportions of chemical elements (carbon, silicon and so on), to act on the non-metallic inclusions suspended in cast-iron, which according to an improved theory, determine by reason of their manner of production and their distribution in the metal, the shape and dimensions of graphite as well as the structural anomalies above referred to.

According to this invention, the after-treatment comprises pouring the metal from the blast-furnace into a mixture of iron or steel shavings and hammer-scale. Any other divided scraps may be substituted for shavings; likewise the hammer-scales may be replaced by ferrosoferric oxide Fe_3O_4 from other sources. Instead of the said mixture of shavings and hammer-scales, I may also use any other granular or powdery material substantially consisting of iron and iron oxides.

A portion of the oxygen in the oxides will burn a part of the carbon in the cast-iron, thereby producing CO and CO_2; another portion, by combining with silicon, will yield an amount of heat larger than necessary for decomposing oxides. Such heat, together with the sensible heat in cast-iron above solidification temperature, will be available to melt ferrous metallic materials after reduction of any oxides present therein. Finally a part of the addition is converted into slag together with the oxidation products from cast-iron (MnO_2, SiO_2 and the like). Thus with a properly calculated addition of a mixture of shavings or iron scraps and hammer scales, the carbon and silicon contents are lowered and a slag is obtained, the properties of which control the graphitisation form of cast-iron. The production of this slag as a result of addition of iron oxide is one of the characteristic features in this invention.

According as the case may be, the respective proportions of iron or steel and iron oxide may vary within broad limits.

The above mentioned additions may be made either in the runner or in a suitable vessel, either stationary or movable, either heated or not, and into which cast-iron is poured. They may be made continuously in the runner or the vessel or by one or more batches.

Where a vessel is used, the addition is found to be more efficient. Furthermore, this process enables of checking results by cursory chemical analysis and by means of test-pieces, well known in the art, wherefrom the carbon and silicon content can be appreciated with sufficient precision. Thereby, it is possible to produce a cast-iron having a predetermined composition, and possessing the advantages of a "controlled" structure. It is also possible to produce very homogeneous metal by mechanically stirring for instance by rotating the furnace, by creating a rotating field with polyphased currents, by a pneumatic process and so on.

Good results were secured by placing in a ladle suitably alternating layers of shavings and hammer-scales, and pouring cast-iron at first at one point to enable cast-iron of running to the bottom of the ladle, then moving the ladle or the jet to sprinkle the whole mass of non-melted metallic materials, finally introducing dry wood poles into the molten mass to stir it as a result of gas evolution.

As an example, in a batch of 7,030 kg. of cast-iron the original contents of C=3.50 per cent and Si=3.08 per cent (with manganese=0.90 per cent; phosphorus+sulphur less than 1.10 per cent) were lowered to C=3.31 per cent and Si=1.98 per cent by adding 205 kg. of shavings and 400 kg. of hammer-scales. In a batch of 8,600 kg. of cast-iron, the carbon content was brought from 3.27 per cent to 2.97 per cent by adding 790 kg. of shavings. In a batch of 6,920 kg. of cast-iron, the carbon and silicon content were brought from 3.25 per cent and 4.66 per cent respectively to 3.05 per cent and 3.52 per cent respectively by adding 234 kg. of shavings and 575 kg. of hammer-scales. Finally, in a batch of 6,530 kg. of cast-iron, the carbon and silicon content were brought from 3.09 per cent and 3.68 per cent respectively to 2.76 per cent and 2.33 per cent respectively by pouring it upon 310 kg. of shavings, 905 kg. of hammer-scales and 202 kg. of pyrite ashes.

When oxygen containing materials are added an exothermic reaction takes place, whereby the amount of shavings or divided iron scraps may be increased.

On the other hand, the carbon and silicon contents may be adjusted and the cast-iron structure may be altered in such a way as to produce a homogeneous structure.

The invention allows of producing new types of cast-irons (more particularly as soon as they leave the blast-furnace) the carbon content of which may vary from 3.40 to 2.40 per cent and the silicon content may be lowered to 1.5 per cent with a homogeneous structure and no ferrite stains; no similar cast irons have ever been produced up to this time even in a special furnace.

LÉONCE REYGAGNE.

Published June 1, 1943 Serial No. 416,914

ALIEN PROPERTY CUSTODIAN

PROCESS OF RUSTPROOFING METALS AND OBJECTS WITH A METALLIC SURFACE

Aegidius Lankhorst, Nijmegen, Holland; vested in the Alien Property Custodian

No Drawing. Application filed October 28, 1941

The invention relates to a process of rustproofing metals and objects with a metallic surface.

Several processes of rustproofing metals, such as iron or steel, or objects with a metallic surface, such as a surface of iron or steel, have already been applied. One of the methods which has been particularly used by the cycle-industry consists in the provision of a coating of lacquer on the metal tubes or the like for rustproofing same. It has, however, been found that this process is not effective, because the metal gets rusty under the coating of lacquer, especially when the metal has been cleaned with acids; consequently the coating of lacquer gradually cracks and chips off and the uncovered parts of the metal are exposed to the air thus facilitating the rusting of the metal.

The object of the invention is to quickly and effectively rustproofing metals or objects with a metallic surface in a manner which involves few costs and does not require complicated apparatus.

The invention is now characterized by the fact that the metals or the objects to be treated are immersed into a diluted solution of phospheric acid containing zinc or iron or a zinc- or iron-compound dissolved in the phospheric acid and glycerine, after which the metals or the objects thus treated are removed from the solution and then washed and dried.

The object thus obtained does not tend to rust and is absolutely proof against the action of moisture or other oxidizing or rusting influences. In order to increase the rustpreventing action the treated objects may be provided with a protective coating, such as a coating of lacquer which firmly adheres to the metal and does not tend to crack or to chip off.

The invention is elucidated by the following example. The surface of the object to be treated is well cleaned in order to remove dirt, grease, oxides etc.

The object thus treated is then immersed into a bath having a temperature of 203° F. and being obtained by adding to 110 litres of water a dough obtained by mixing 833 g of phospheric acid, 300 g. of zinc-dust and 500 g. of water and setting aside the mixture for some hours. Thereupon 143 g. of glycerine (28° Bé.) is added to the bath.

After the object has been subjected for 12 minutes to the action of the bath, same is removed from the bath, washed with water of 203° F. and then dried.

AEGIDIUS LANKHORST.

ALIEN PROPERTY CUSTODIAN

APPARATUS FOR DETECTING UNDERGROUND LYING METALLIC OBJECTS

Henri Chireix, Paris, France; vested in the Alien Property Custodian

Application filed November 18, 1941

The object of the present invention is to provide a plain rugged and portable apparatus enabling anyone to detect underground lying metallic objects such as shells or mines.

The principle of construction of the apparatus which will be hereinafter described, according to the invention, is the following:

If in a closed circuit comprising a loop and a condenser there flows an alternating current of a sufficiently high and stable frequency, the magnetic field of the said loop induces in the said underground object eddy currents which produce a counter-field, thus slightly modifying the characteristics of the circuit, which modification is indicated by the apparatus.

The apparatus to be designed being of the portable kind, with a loop of the order of 50 centimeters diameter, the existence, at distances of the order of one meter, of metallic objects. even of moderately important size will only modify the apparent self-induction of the loop in a measure of the order of 10^{-5} (one or several one hundred thousandths). By reason of such circumstances, the invention provides for the following conditions:

1. The frequency of the currents flowing in the closed circuit must be very stable;
2. The said closed circuit must be most approximately tuned at resonance;
3. The indicating apparatus must be extremely sensitive to tuning variations.

The means for the embodiment of the invention comprise principally, in combination:

1. A frequency generator consisting in a very slightly loaded valve generator, coupled with the circuit in which the aforementioned loop is included;
2. An electric circuit, comprising the loop. of a very high quality, which means of a most high selectivity;
3. An indicating apparatus, of the phasemeter type, indicating the phase variations of the current in the circuit with reference to the phase of the generator voltage. Such phasemeter acts on the indicating apparatus itself (for instance, a lamp signal).

The frequency to be used shall be comprised in a determined frequency band, in order to take into account, first, that electrostatic effects must be made negligible and, second. that currents induced in the ground itself must also have but a negligible effect.

For instance, in order to reduce electrostatic effects, the search loop must have only one winding of low resistance and the wavelength shall be preferably chosen at least equal to hundred times the developed length of the said loop, that is, to at least 157 meters for a loop with a 50 centimeter diameter. In fact, in an apparatus actually designed and constructed, the wavelength is 300 meters, which means a frequency $f=10^6$ cycles. These considerations thus give an upper frequency limit. The lower frequency limit is determined by the other considerations, that is, the possibility of realizing a high quality circuit and the influence of the ground. Practically, the band of usable frequencies coarsely lies between 2.10^5 and 2.10^6.

The invention is illustrated in and by the following drawings, in which:

Figure 1 diagrammatically shows the apparatus according to the invention and

Figure 2 is schematic diagram of the circuit used.

Referring to Figure 1 of the drawings, the circular loop 1 is made of a light metal tube carried at the end of an insulating rod 2. The main tuning condenser is a mica insulated condenser, with a capacity of the order of 20,000 micro-microfarads, located at point 3, where the said tube is fixed on the insulating rod.

The tube itself is preferably enameled, in order to avoid a partial short circuit, if it comes in contact with the wet ground.

The fitting of the loop on the rod must also be carefully made, in order to avoid any defective insulation.

The signalling lamp 4 is also located away near the far end of the rod, so as to allow for simultaneously looking at the position of the loop near the ground and at the signalisation of the lamp.

The carrying end of the rod is held under the operator's arm and, at the height of its hand, it is provided with an adjustable vernier condenser 5, in shunt with the main condenser. Such vernier condenser with a capacity of but a few micro-microfarads locates the working point of the phasemeter in the used portion of its characteristic curve. Next to the vernier condenser is also located a main switch 6. Finally, the end of the rod farthest from the loop is connected, by means of a cable 7, with the main apparatus, lodged in a casing 8, carried on the operator's back.

Referring now to Figure 2 of the drawings, there will be described the electrical circuit of the apparatus. L_1 and L_2 are the two valves of the said circuit. They may be, for instance, two triodes, or two pentodes, preferably connected and used as triodes, with low heating current cathodes,

both cathodes being series connected with a 4,5 volt battery P_1. Valve L_1 is used for the generation of the oscillations and L_2, for the actuation of the indicator. For such purpose, L_1 is connected with a tunable circuit comprising the primary of a voltage lowering transformer M, with iron powder core, a main fixed capacitor C_1 and an adjustable vernier capacitor C_2. Coupling capacitor C_3 and grid leak R_1 complete the generator unit the anode voltage of which is supplied by means of a 90 volts battery P_2; a suitable decoupling condenser C_4 being connected in the circuit.

The search circuit comprising loop S is tuned by means of the fixed capacitor r_1, located in the in the immediate vicinity of the said loop, and of adjustable capacitor r_2, carried on the rod, as has been hereinbefore stated. The terminals of the conductor fixed to the carrying rod are connected to the terminals *a* and *b*, on the main apparatus casing.

The circuit of the said main apparatus are excited by means of an adjustable coupling condenser r_3, the capacity of which amounts to but a few micro-microfarads. There is, in fact, visible that starting at the anode of valve L_1, a circuit comprising, in series, r_3, r_2, C_6 (C_6 being a capacitor with a large capacity value for instance 0.05 microfarad) closes itself at the ground, that is at the cathode of valve L_1. By virtue of the well known properties of coupled circuits, the voltage at terminals *a*, *b* is, the search circuit being at resonance, in phase quadrature leading on the voltage at the secondary terminals of M. The voltage amplitude across *a* and *b* is, moreover, a rather low part of the voltage across the armatures of C_1, and is adjustable by acting on r_3.

On the other part, the secondary terminals of the screened transformer M are connected in order to feed two dry rectifiers D_1 D_2, the circuit of which is closed on two high and equal resistors R_2 and R_3, the resistance of which may be 200,000 ohms, which are shunted by means of two equal capacitors C_5 C_6.

This part of the circuit appears to form a Wheatstone bridge, one diagonal of which is fed by the search circuit, and the other by the secondary of M. The voltage amplitude across terminals *a b* having been adjusted by means of capacitor r_3, at such value that it substantially equals the voltage developed on one half of the secondary of M, it appears that, at resonance of the search circuit, each one of both detectors D_1 and D_2 is under the same resulting voltage, practically equal to $\sqrt{2}$ times the voltage across *a b* (two voltages equal and in phase quadrature one with the other).

Under such conditions the rectified voltage across ground and R_4 is zero. On the contrary, as soon as any metallic body present happens to reduce the apparent self-induction of loop S, the voltage across *a b* begins to lead by a definite amount, so that, the two voltages being no more in exact quadrature the voltage rectified by D and smoothed across the terminals of C_5 becomes less than that rectified by D_2 and smoothed across the terminals of C_6. Thus there appears a negative voltage across ground and R_4.

Reciprocally, an electrostatic effect on the loop would cause the appearance of a positive voltage across ground and R_4.

Such voltage is used to bias valve L_2, the resistor R_4, of high resistance (1 megohm for instance) preventing electrostatic effects to bring the grid to any potential appreciably positive with reference to the cathode.

A signaling relay Q, provided in the anode circuit of valve L_2, will therefore be able, as the current through it will fail, to close contacts actuating the signalling lamp V. Finally therefore, capacitor r_3 having been adjusted once for all, as well as main vernier capacitor C_4, vernier capacitor r_2 will be adjusted at such a value that relay Q will attract its armature, thus causing the opening of contacts, which will mean, for instance, that the grid of valve L_2 is slightly negative. Therefore, any variation causing the grid of valve L_2 to become more negative will cause the armature of relay Q to fall and the lamp signal to be lighted. There has been also provided acoustical signalling means consisting in a buzzer, the contact of which is shunted by a telephone receiver T. The buzzer is located inside the casing and the receiver is mounted, by means of a jack connector, on a head set carried by the operator.

Finally, the main switch I is also carried on the rod.

There has thus been possible to devise and realize a whole apparatus weighing less than 4 kilograms together with batteries and valves and consuming less than one watt supply power.

According to a modification, the vlavc L_2 may be substituted by a cathode ray indicator tube, the same being also directly placed on the carrying rod of the apparatus.

HENRI CHIREIX.

PUBLISHED

JUNE 1, 1943.

BY A. P. C.

H. CHIREIX

APPARATUS FOR DETECTING UNDERGROUND LYING METALLIC OBJECTS

Filed Nov. 18, 1941

Serial No. 419,545

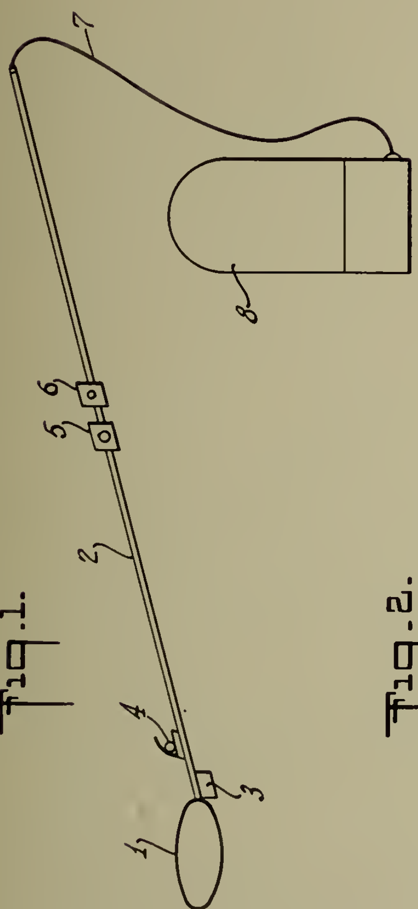

Fig.1.

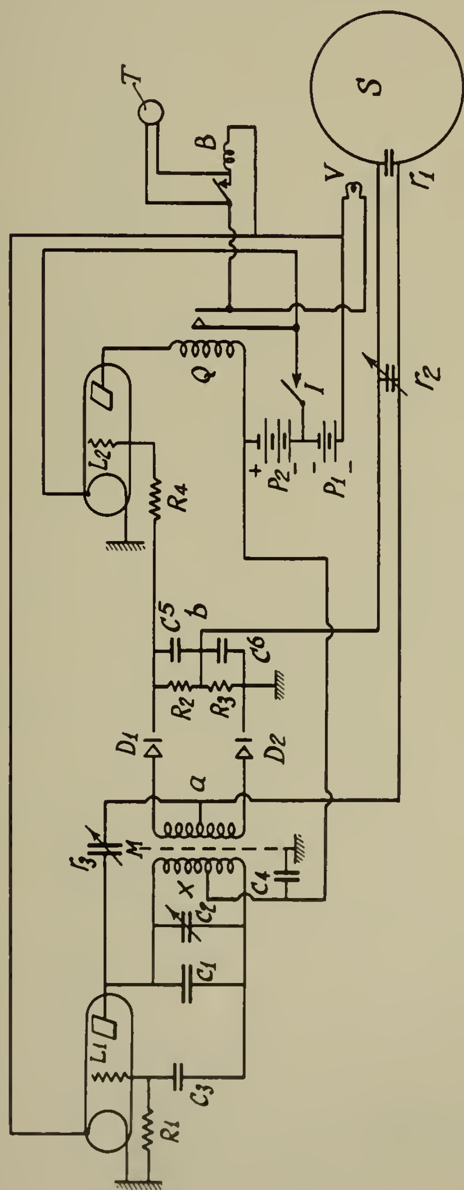

Fig.2.

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Published June 1, 1943

Serial No. 420,819

ALIEN PROPERTY CUSTODIAN

PROCESSING OF WOOD SUGAR SOLUTION

Heinrich Scholler, Munchen, Germany; vested in the Alien Property Custodian

No Drawing. Application filed November 28, 1941

This invention relates to the processing of wood sugar solution and particularly to a method for the purification of wood sugar solutions.

Wood sugar solutions of the kind occurring in large quantities in the saccharification of cellulose by hydrolysis with dilute acids, besides simple kinds of sugar also contain considerable proportions of undesirable admixtures which are detrimental for some purposes, for instance, where baking yeast is to be produced from wood sugar, or where wood sugar is to be used as an animal foodstuff or as an initial product for the production of crystallised dextrose.

It is an important object of the present invention to provide a method which in a simple manner permits separation of said admixtures from the wort to a degree of purity sufficient for the said purposes, which was not hitherto possible.

I have now found that after thickening of the wood sugar solution, for instance, to a specific gravity of 1.35, and after letting stand the substance for a period of several hours, at temperatures above 60° C., approximately, and extensive resinification of the undesirable admixtures takes place. Vacuum may be used for thickening the solution, if desired.

The separation products may be removed from the sugar solution by centrifuging, filtering, clarifying or by decantation. By way of alternative, said treatments may be used in combination. Since the resinous separations partly are agglomerated, they may also be removed by sieving, i. e., by clearing.

The resinification may be carried out at temperatures below or above 100° C., but a temperature range of 90 to 100° C. will be preferable since below 80° C. the process proceeds very much more slowly, while the application of considerably higher temperatures would require the use of pressure vessels without offering substantial advantages. Preferably the process is carried out in the vicinity of the neutral point or in a slightly acid agent.

It is of special importance for the process of resinifications that an optimum specific gravity is maintained. I have found that the resinification proceeds very well at a specific gravity of S=1.3 to 1.4. It is desirable to ascertain the optimum specific gravity for each raw material by preliminary tests.

The heat treatment is carried through for several hours, preferably under stirring, the actual length of time for this treatment depending on the initial product the desired degree of purity. After the wort has been heat-treated for several hours, the same is suitably cooled down to a temperature below 50° and let stand for several hours, whereby the separation and removal of the resinous products is promoted.

My novel method primarily relates to the treatment of wood sugar worts produced after the percolation method from leaf wood or coniferous trees, but sugar worts made from other cellulose-containing substances may also be purified after my novel process. My process is adapted especially also for the refining of the various percolation fractions obtained according to the process described in my U. S. Patent No. 2,188,193, in which the first fractions are separated and used for the production of pentoses, while the later fractions of the percolation process serve for the manufacture of crystallised dextrose. My novel method may be used in any of these and similar cases. One or more fractions of the wood sugar solution, if desired or required the later fractions, containing about the second half of the yield of reducing sugar, may be treated separately. For instance, by evaporation and crystallisation of the later fractions, without application of my purifying method, a crystallised product has been obtained containing about 90 parts by weight of dextrose in 100 parts dry substance, while in a comparative test, starting from solutions subjected to a preliminary treatment according to the present invention, a product containing 98 to 99 percent glucose per 100 parts by weight has been obtained already in the first crystallisation, after centrifuging in known manner. The crystallisation may be carried out according to the methods known in the art for glucose.

In order to facilitate the separation of the resinous products from the solution by means of centrifuging, filtering, clearing or decanting, a certain amount of water is advantageously added thereto. The separation may be facilitated considerably already by a reduction of the specific gravity by dilution to a figure of 1.28 to 1.30.

The removal of the deposit or precipitate may take place immediately upon addition of the water. Upon removal of the precipitates the clear solution is suitably concentrated again so as to meet the purpose for which it is intended.

The separation products are soluble entirely or partly in alkalis, ketones, alcohols, and in furfurol, and may be used for the production of varnishes or lacquers and mordants, either alone or admixed with shellac. The wood sugar solutions thus purified and thickened are adapted not only for the production of crystallised dextrose but

also for the production of baking yeast and for use as animal foodstuff, or as a constituent for mixed animal foodstuff, resp. The mother liquors occurring in the crystallising process—after repeating the above described purifying process, if desired—may also be used for the manufacture of baking yeast or as an animal foodstuff.

Example

The later fractions of a percolation process containing about one-half of the total amount of sugar after being neutralised by means of ground limestone are evaporated under vacuum to a specific gravity of 1.34, and then maintained, for a period of about eight hours, at a temperature of 90 to 100° C., under stirring, this resulting in the separation of resinous masses. After eight hours' treatment the solution is cooled down and let stand for several hours, whereupon the specific gravity is adjusted to S=1.28 by addition of water. Then the resinous masses are removed from the solution, by centrifuging in solid jacket centrifugal machines.

The resinous masses are subsequently washed by means of water and dried. The yield of resinous products amounts to about 5 to 10 percent by weight of the total dry substance of the sugar solution.

The purified sugar solution then is boiled down under vacuum to a specific gravity of 1.35 to 1.40, and preferably 1.39. The solution thus processed may be crystallised according to the methods known in the art for starch sugar.

The method of the present invention has been described in detail with reference to specific embodiments. It is to be understood, however, that the invention is not limited by such specific reference but is broader in scope and capable of other embodiments than those specifically described.

HEINRICH SCHOLLER.

Published June 1, 1943 Serial No. 421,166

ALIEN PROPERTY CUSTODIAN

READING STANDS

Chain Ki Ku, Kowloon, Hong Kong; vested in the Alien Property Custodian

Application filed December 1, 1941

This invention relates generally to book holders and has particular reference to what are usually referred to as reading stands.

One object of the invention is to provide a reading stand which will hold a book in substantially any position desired by the reader. This involves making provision for adjustments as to height and the angle at which the book is held, while the stand is so constructed as to be light in weight and therefore readily movable to set it at any desired distance from the reader.

Another object is to provide a reading stand of the character mentioned which can be partially knocked down or in effect collapsed so as to occupy a small space when not in use. This involves in the novel structure shown and described, the loosening of only one set screw to permit removal of a book holder unit from its normal position on a vertical standard, coupled with a simple and new means for holding the removed unit close to and in substantially parallel relation to the vertical standard.

Another object of the invention is to provide a support for an open book comprising convenient and novel means for preventing the leaves from turning except when turned by the reader. This means is readily adjustable to accommodate books of different sizes and thicknesses.

Still another object of the invention is to provide a novel device for holding the book holder unit in adjustment at different heights on a support while leaving the book holder free to rotate around the support. This is accomplished by providing an element, such as a sleeve, which can be adjusted at the desired height on the support and then secured in position; and a second element, preferably also a sleeve, which is rotatable on the support and to which the book holder unit is attached with a connection between the two sleeve elements which will prevent them from separating while making the height adjustment. This connection is also useful in collapsing the device for storage as the connection is maintained and the connected parts are therefore in proper relations when the book stand is taken from storage and set up for use.

With the foregoing and incidental objects and advantages in view, all of which will become more apparent later on, the invention consists in a novel construction and relative arrangement of parts, a preferred embodiment of which is hereinafter described with reference to the drawings accompanying and forming a part of this specification, the novel features of the invention being pointed out in the claims appended hereto.

In the drawings:

Fig. 1 is a top view of the reading stand set up ready for use.

Fig. 2 is a front view of the reading stand with some of the parts at the right of the figure being shown in cross-section.

Fig. 3 is a view of the book holder or rack with a book in position and the means for holding the book open about ready to be applied.

Fig. 4 is a section along the line 4—4 of Fig. 2.

Fig. 5 is a section along the line 5—5 of Fig. 2.

Fig. 6 is a section along the line 6—6 of Fig. 5.

Fig. 7 is a section along the line 7—7 of Fig. 5.

Fig. 8 is a top plan view, and

Fig. 9 is a side view of the reading stand collapsed ready to be stored away when not in use.

The construction illustrated in the drawings comprises a rather wide base **10** on which is mounted a vertical standard **11**. An escutcheon **12** may be employed to provide a socket for the standard or the part **12** may be integral with the base **10**. Slidably mounted on the standard **11** are two elements **13** and **14**. These two elements are connected together as shown in Fig. 5. The elements **13** and **14** will from now on be referred to as sleeves, but it is understood that this term is used mainly for convenience. The sleeve **14** has a reduced section **15** constructed to provide a peripheral groove **16**. The sleeve **13** is constructed to provide a socket to receive the reduced portion **15** and around the periphery of the socket are set screws **17** which have their ends extended into the groove **16**. This provides a connection which permits relative rotation of the sleeves **13** and **14** but the two sleeves are normally held against longitudinal separation. This permits the raising and lowering of sleeves **13** and **14** as a unit in adjusting the height of the book holder on the standard **11**.

The sleeve **13** has a longitudinal groove along one side in which is mounted a friction block **18** backed up by a metal strip **19**. Working against the metal strip **19** is the end of a set screw **21** threaded into the body of the sleeve **13** or into a metal plate **22** which is used when the sleeve **13** is constructed of wood. Loosening and tightening the set screw **21** will relieve and restore pressure by the friction block **18** against the standard **11** so as to free the sleeve for adjustment and then secure it at the desired level on the standard **11**. Plungers **23** extend from the exterior of the sleeve **13** into holes in the friction block **18** so as to prevent the latter from falling out when the sleeve is not in position on the standard. The plungers are preferably provided

with heads fitting snugly in holes in the sleeve 13, although frictional fit between the plungers and the holes for them in the sleeve 13 and friction block 18, may be sufficient for all practical purposes.

Secured to and at right angles to the axis of the sleeve 14 is a bar 24 which is rectangular in cross-section at the point where it is connected to the sleeve. Screws 25 may be used for connecting the bar to the sleeve.

The bar 24 is given a circular cross-section 26 at one side of the sleeve 14 and is preferably rectangular in cross-section at the portion 27 lying at the other side of the sleeve.

Secured to the upper surface of the rectangular portion 27 as by screws 28 is a tray 29. This tray may be of any desired size or shape and weight and is used mainly to hold books or any desired article which, in addition to the weight of the tray, serves as a counterbalance when heavy books are on the holder at the other end of the bar 24.

Slidably mounted on a circular or tubular section 26 of the bar 24 is a member 31 provided with a clamping set screw 32 and associated construction similar to that described in connection with the set screw 21. The set screw 32 may be tightened and loosened to hold the member 31 in any longitudinal or angular relation with the bar 26. By this means the block or member 31 may be moved toward and away from the supporting vertical standard 11 and may be turned around the tubular or circular bar 26 so as to adjust the book holder supported by the member 31 in the desired position and then secure the adjustment by means of the set screw 32. As shown in Fig. 4, the member 31 is provided with a circular portion 33 normally fitting within a correspondingly shaped socket 34 in a member 35. The member 35 is provided with a set screw 36 and friction block 37 by means of which the member 31 may be turned around the projection 33 and then fastened by tightening the set screw 36. This adjustment is to permit changing the angle of the book holder relative to the shaft or bar 26 whenever such adjustment may be desired.

The member 31 is attached by means of screws 41, Fig. 2, to one of the bars 42 of the book holder or rack. In addition to the bar 42 the rack comprises two or more additional bars 43 spaced apart from and extending parallel to the bar 42. The bars 42 and 43 are held together and in the relation stated by bars 44. The latter bars preferably extend below the lower bar 43 and carry a ledge 45 for supporting a book A. This ledge may be of sheet metal or any other desired material and may be attached in any desired way to the bars 44.

On the rear side of one of the bars 44 is a metal plate 46, Fig. 10, provided with a ridge 47 to engage a slot 48 in an arm 49, which at its upper end is provided with any suitable kind of a holder for a reading lamp. The arm 49 is held in adjusted position by a set screw 51 which may be tightened in a threaded hole 52 in the plate 46.

From all of the foregoing it is apparent that by manipulating the set screws 21, 32 and 36 the height and angle at which the book holder will be held may be adjusted as desired, thereby providing a very flexible arrangement adapting the device to the requirements of the user.

After a book has been placed on the ledge 45 and opened to the desired page, the pages are held against accidental turning by threads 53 which are drawn across the open book and then secured. While the term "threads" has been used it is intended to include in that term any suitable cord or elastic which will serve the purpose. The threads 53 are all really a part of one thread which is secured at the end 54 in a bar 55 and which passes down through holes 56 at the end of the top bar 43, then up through a corresponding hole in the bar 42 through spaced apart holes in the bar 55 and down through another hole 57 in the lower bar 43. The number of threads and the arrangement of the threads relative to the bar 55 will vary according to the number of bars 42 and 43 comprised by the book holder. On the back of the lower bar 43 is a hemispherical chock 61. The thread 53 is let out or taken up as needed to get the desired adjustment and the free end of the thread is then wound around the chock 61. The threads 53 are drawn across the open book by manual movement of the bar 55 to engage the threads with notches 62 in the ends of the bars 42 and 43 and the bar then held with its flat face 63 on the undersides of the bars 42 and 43. The slots 62 are deep enough and the arrangement is such that the threads will be held across the open book and prevent the turning of the leaves. This is best illustrated in Fig. 1 of the drawings. It is apparent, of course, that the bar 55 may be seated under the bars 42 and 43 with the threads in the notches 62 and the threads then adjusted endwise and secured by the chock 61 when such an operation is desired. It is apparent that by this arrangement and way of holding the threads books of various sizes may be accommodated in reading position.

When it is desired to put the reading stand away it may be knocked down or collapsed as previously stated. This involves loosening the set screw 21 and then sliding the sleeves 13 and 14 and all of the parts attached to them off of the vertical standard 11. This assemblage is then turned and put in position parallel to the vertical shaft 11 with the edge of the counterbalancing tray 29 in a slot 64 in the upper surface of the base 10. The parts are held in this relation by a flat member 65 having two circular openings, one to engage the standard 11 and the other to engage the circular part 26 of the main horizontal bar of the reading stand. The entire apparatus will then appear as shown in Figs. 8 and 9. When the stand is set up and in use the member 65 may be kept under the counterbalancing tray 29, preferably by engaging a slot 66 in its side with a headed stud on the underside of the tray. This is illustrated in Fig. 1.

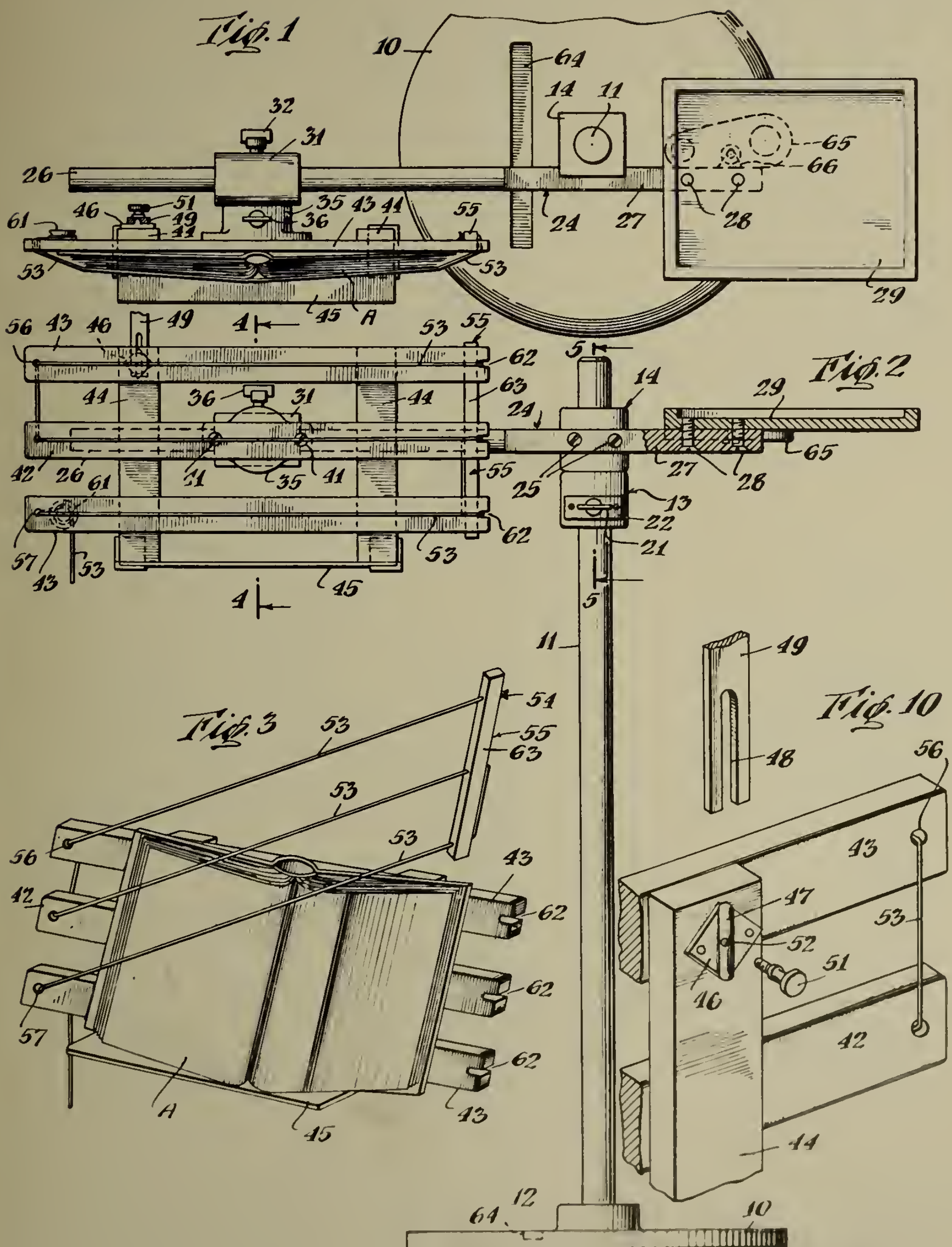
The base 10 may be of any size or shape sufficient to give stability to the stand when it is in use. It is preferred to make the base wide and flat enough to hold books both as a matter of convenience and in order to serve as counterbalances in the direction desired for the stand, particularly when a heavy book is put on the book holder.

CHAIN KI KU.

PUBLISHED JUNE 1, 1943. BY A. P. C.

C. K. KU
READING STANDS
Filed Dec. 1, 1941

Serial No. 421,166
2 Sheets-Sheet 1



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PUBLISHED
JUNE 1, 1943.
BY A. P. C.

C. K. KU
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Serial No.
421,166
2 Sheets-Sheet 2

Fig. 8

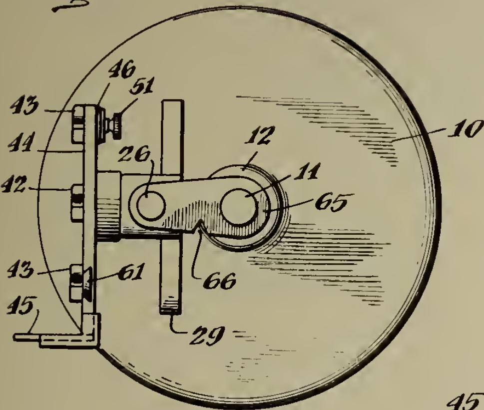


Fig. 4

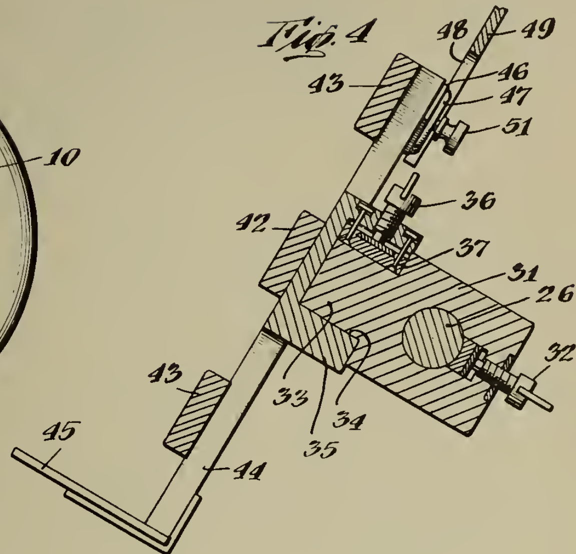


Fig. 9

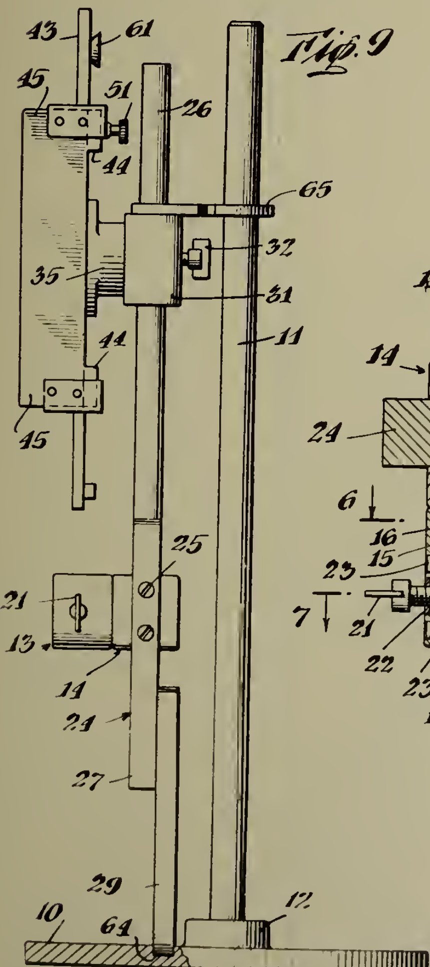


Fig. 5

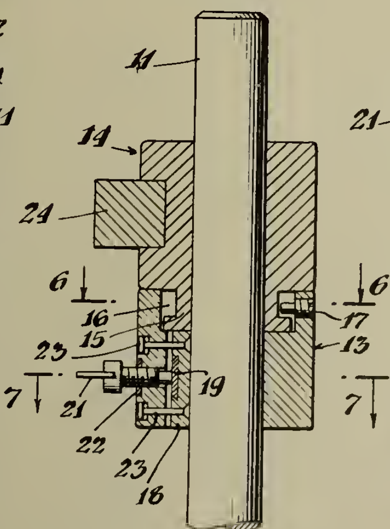


Fig. 6

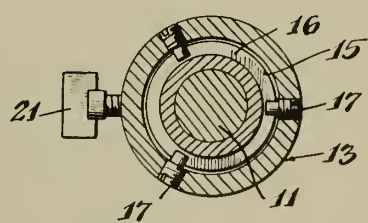
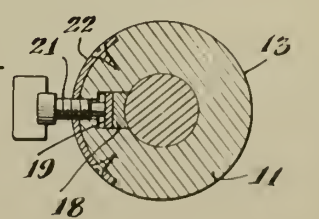


Fig. 7



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Published June 1, 1943 Serial No. 422,173

ALIEN PROPERTY CUSTODIAN

PROCESSES OF FILMING, TAKING AND PHOTOGRAPHY AND KINEMATOGRAPHIC PROJECTIONS RENDERING POSSIBLE TO OBTAIN ON AN ORDINARY SCREEN PICTURES IN RELIEF AND NATURAL COLORS

Pierre Osorio, Nice, France; vested in the Alien Property Custodian

Application filed December 8, 1941

The invention consists of processes of filming taking and photography and kinematographic projections rendering possible to obtain on an ordinary screen pictures in relief and natural colors by means of ordinary films in white, gray and black.

It can be understood by means of the drawings attached as an illustration of the present description.

Fig. 1 shows in schematic form the camera with object-glass consisting of lenses. Through object-glass AB, picture C of scene D is operated at the diametrical dimension of approximately ½ millimeter and increases its size on the front side of a convergent lens E, from where the light emerges in a pencil of parallel rays, that the cylinder-shaped lens F converges on its focal axis. A divergent cylinder-shaped lens G projects its rays in a beam H of a reduced thickness that a prism I analyses in a spectral band J of the picture D shaped on E.

Fig. 2 shows in a schematic section a telescopic device which gives the same results as objective AB of Fig. 1. Reflected on a parabolic mirror of a telescope of the "Gregory" type, the scene to be filmed at a reasonable distance would reproduce its punctiform picture at point K of the said mirror if a little mirror, plan L reflected it at the opening M of a dark room N where is reproduced system E—F—G—H—I—J of Fig. 1.

Fig. 3 shows in a schematic section the telescopic device which gives the same results as those of Fig. 2—Reflected on to the parabolic mirror of a telescope of the "Newton" type, the scene to be filmed at a reasonable distance would reproduce its punctiform picture at point 0 of the said mirror, if a little mirror, inclined at 45° on the axis of the telescope reflected it at the lateral opening P of a dark-room where is reproduced system E—F—G—H—I—J of Fig. 1.

Fig. 4 shows a schematic view of the camera. A beam A of parallel rays emanating from a source of appropriate light refracts itself through a prism 6 in a spectral band on the cylinder-shaped lens converging C functioning as a condenser and converges these rays of colors through the positive *d* of the film to be projected as well as through the prism *c*, from where they emerge as beam *f* of parallel rays that the system of cylinder-shaped lenses *g* and *h* develop in a pencil of rays *i* parallel, and lens *j* projects on the screen *kl* as picture *m*.

The invention concretes itself first so as to endow a camera with a device capable of reducing the diametrical size of the pictures to approximately ½ millimeter, so that the rays usefully captured by the protruding lens of this objective will converge to the imaginary punctiform opening of a dark-room. Secondly, so as to dissociate the picture from the scene to be filmed in all its length waves selected and graduated on a spectral band. Thirdly, so as to recompose exactly, by a reversal of the rays through the moving-picture projector, what the camera had decomposed or analysed.

It rests on the propriety of panchromatic films being sensible to all colors. In fact, when a color is missing, the corresponding zone of the spectre of the scene filmed will appear in black on the positive to be projected,—therefore that color will not be projected. And likewise, the positive will let pass at the projection more colored light because of the fact that the negative will have been printed by stronger colors, as the corresponding zones will be closer to the white on the positive.

These qualities of the panchromatic emulsions not being rigorous it will be necessary to interpose on the passage of the rays a filter intended to lessen the disadvantages of this defect by absorbing partially, either at the filming or at the projection, the zones of the chemical action of the light relatively too strong which give on the positive some zones which let pass the light through in a relatively too strong a manner for the projection. This filter special for all brands of films and relating to the light used at the taking of the film and at the projection will be, either printed at the manufacture on the reverse side of the film, either colored on one side of the lens or the prism, or interposed on the aerial passage of the luminous rays such as the colored screens at present in usage.

The cameras of Figs. 1, 2 and 3, the aim of this invention, realize mechanically a distortion of the pictures which gives the impression of an aerial view by operating these pictures, entirely to the point, on the front side of lens E, from where the light emerges in a pencil of parallel rays, which it is sufficient to cut by a screen to realize an even picture of this spherical deformation of the scene to be filmed.

The curved ray of the front side of lens E should therefore be chosen practically as giving the best sensation of depth of the pictures.

Furthermore, if in the E—F—G—H—I—J system of the cameras, only lens E is kept and a film is taken by means of the emerging beam—the pictures figuring which will be obtained will give this same sensation of aerial view. The use of the cameras of Figs. 1, 2 and 3 reduced to their objective system and to lens E, so as to obtain the monocular relief in the figured pictures as is actually in usage in kinematography and photography and therefore form an integral part of this invention.

PIERRE OSORIO.

PUBLISHED

JUNE 1, 1943.

BY A. P. C.

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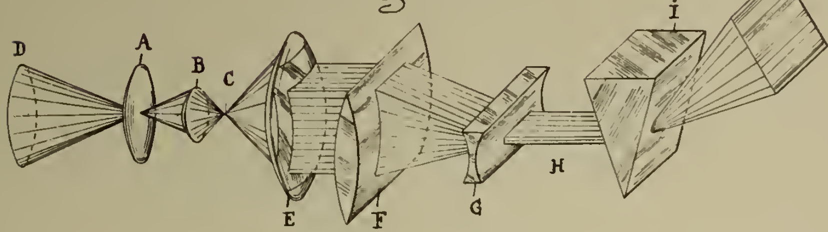
PROCESSES OF FILMING, TAKING AND PHOTOGRAPHY AND KINEMATOGRAPHIC PROJECTIONS RENDERING POSSIBLE TO OBTAIN ON AN ORDINARY SCREEN PICTURES IN RELIEF AND NATURAL COLORS

Filed Dec. 8, 1941

Serial No. 422,173

Fig. 1.



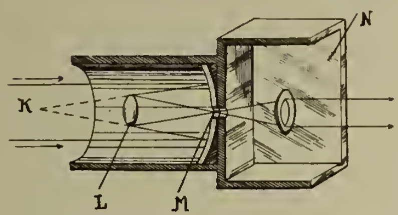
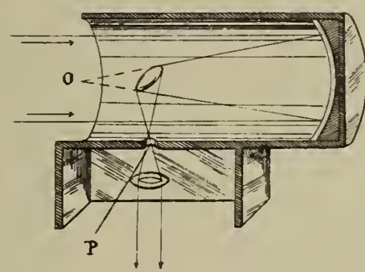


Fig. 2.

Fig. 3.



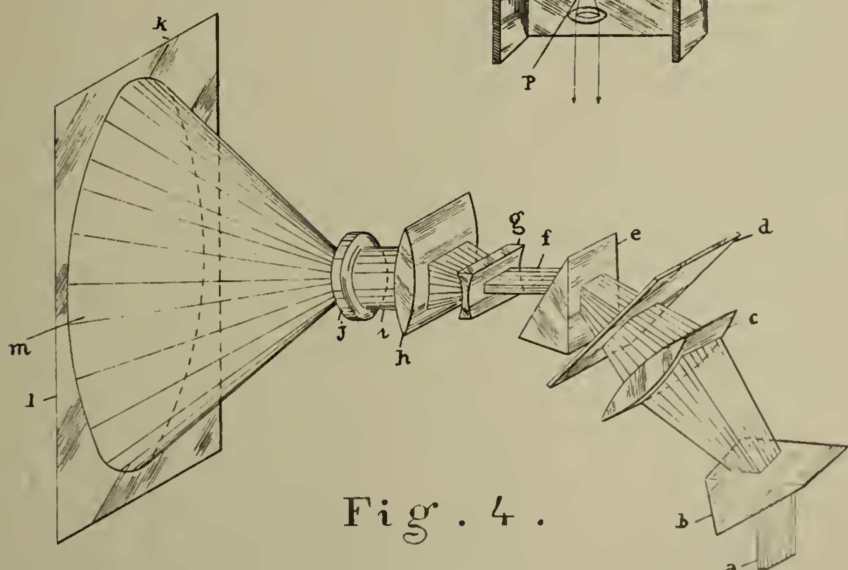


Fig. 4.

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ALIEN PROPERTY CUSTODIAN

MEANS FOR DETERMINING THE ANGULAR ACCELERATION OF AIRCRAFT

Kurt Schulze, Dallgow-Doberitz, Germany; vested in the Alien Property Custodian

Application filed December 12, 1941

This invention relates to means for determining by accurate measurement the angular acceleration of bodies, and more specifically to means for determining the angular acceleration of aircraft.

It is heretofore been proposed to provide means for determining the angular acceleration of bodies, for example, by utilizing and measuring the precession speed of a banking indicator gyro which measures the velocity of angular movement. In such means, a differentiation device is connected with the turn or banking indicator gyro in such a manner that the precession shaft of a measuring member, which can be separately displaced against the action of an elastic force, e. g., a member which indicates directly the angular acceleration, is operatively connected with an eddy current system, whose coupling power is a function of the speed of the displacing movement. One member acts as both measuring member and eddy current member, and is disposed eccentrically with respect to the precession axis of the gyro, the end of said member lying between the poles of a U-shaped magnet. Whenever a precession of the banking indicator gyro occurs, the magnet will either tend to arrest or brake the eddy current member or to accelerate its movement, depending upon the arrangement. The force of the eddy currents is proportional to the precession speed and consequently to the acceleration of the angular movement acting upon the gyro.

The illustrated embodiment of the invention herein proposed and hereinafter described, by an original means of installing a separate measuring member and a separate eddy current member, and by a symmetrical disposition of the magnet about the axis of precession, by a torsionally-elastic sleeve, and by a novel means of operatively interconnecting the precession shaft, the eddy current member, and the measuring member together will result in a marked improvement over devices heretofore known.

In the present invention, an eddy current system is disposed about the precession axis. The measuring member has the form of a pointer and is freely suspended on the precession shaft. Inasmuch as the eddy current member and the magnet system are symmetrically disposed around the precession shaft, the eddy current member will always be under the full influence of the magnet, whether the deflection be large or small, and this feature will lend the novel apparatus disclosed herein the maximum capacity for accurate measurement. It will also be made clear from the accompanying drawings and the following description that the device is of great compactness; and this added to the fact that it is substantially vibration-proof will make it particularly suited for use in aircraft.

Other objects of the invention include the provision of means for accurately determining angular acceleration and velocities in vehicles, such as aircraft, and for the simultaneous determination of angular velocities and angular accelerations.

The above and additional objects and original features of this novel device will be more fully pointed out in the following description and the appended drawings. The latter, however, are submitted with the object of illustration and simplification only, and are not to be construed as circumscribing the possibilities of the employment of this invention, nor of limiting the manner in which it may be mounted in an aircraft or other body.

In the drawings, in which like reference characters refer to like parts throughout:

Fig. 1 represents a front elevation, partly in section, of one embodiment of this invention, showing one way of mounting it in an aircraft;

Fig. 2 represents a side elevation of this invention, i. e., an end view as seen from the end on which the measuring member, or pointer, is mounted; and

Fig. 3 is a top or plan view of the structure shown in Figs. 1 and 2.

The drawings thus show three views of one embodiment of this invention comprising an aircraft turn or banking indicator gyro of orthodox design. The gyro, which rotates, for example, in the vertical plane, about an axis 2, which axis lies in the horizontal plane and extends, for example, fore and aft of the aircraft, is enclosed in a housing 1. A horizontal precession shaft or axis 3, 3, which consists of two parts, each of which is rigidly secured to the housing, extends, for example, athwartships of the aircraft. Precession shaft 3 is mounted in bearings 4, 4, which bearings are fixed to the aircraft, or other body whose angular movement is to be measured. On one end of the precession shaft is pinned, or otherwise rigidly fastened, an arm 5, whose motion is restricted by rigidly anchored shackle springs 6, 6. These springs restrain, but do not prohibit, the precessional rotation of the shaft 3, 3. The indicating member or pointer is mounted at the other end of said shaft. A torsionally-elastic sleeve 7 is at one end pinned, or otherwise fixed, to the precession shaft (Fig. 1). Sleeve 7 is of

appreciable length and is constructed preferably of some suitable material, such as, for example, a coil spring, so that it will respond readily to torsional twisting. The said sleeve carries on its free end an eddy current member 9. This eddy current member, which may preferably have the shape of a plate, such as, for example, a circular disc, with a hole in the center to accommodate the precession shaft, is preferably of some non-magnetic but conducting material, such as, for example, copper. The fact that the sleeve is of appreciable length and of resilient material will thus permit the disc to have its motion arrested by braking without communicating a material torque to the precession shaft where it is pinned at the sleeve's other end. In other words, when a braking force is appled to the disc, the sleeve will twist readily and will not interfere with free precessional movements of the shaft, even though shaft and sleeve are pinned together at one end of the latter. Eddy current member 9 rotates in front of a stationary magnet system 8, for example, a field coil of the orthodox annular ring shape, which is preferably concentrically and symmetrically disposed around sleeve 7 and shaft 3. An intermediate member 10, which may have preferably the shape of a segment of a circular disc, is pinned, keyed, or otherwise immovably fixed to the precession shaft 3, so that it will faithfully follow the precessional movements of the shaft. A measuring member 12, having, for example, the form of a pointer, is mounted in a freely turning manner on the end of shaft 3 adjacent segment 10; that is, pointer 12 will turn freely as far as its bearing on the shaft is concerned, but its movements are regulated by other considerations, as will be hereinafter shown.

A member 11, having, for example, the form of a curved lever or link, operatively interconnects the eddy current member 9, the intermediate member or segment 10, and measuring member 12, and thus provides for actuating said measuring member or pointer. The connection is, for example, as follows: member 11 is pivoted at its fulcrum 13 by a connection to segment 10 in a freely turning manner. A pin 14, fixed in the eddy current member 9, extends through an arc-shaped slot in segment 10 and engages the connecting member 11 in a vertical slot as shown in Figs. 1 and 2. Pin 14 does not touch member 10 as the arc-shaped slot is sufficiently wide to prevent this, but it bears against the sides of the vertical slot in link 11 and thus connects eddy current member 9 to said link. Pointer 12 moves back and forth over a registering dial 17 as it is actuated by link 11 in response to precession of the shaft.

The values as indicated by the measurement may be read by electrical or mechanical registering devices or by optical means, or the measurement may be transmitted to other stations by an electrical repeater system. Figs. 1 and 2 show one embodiment of such a system, in which, for example, a sliding contact 18 fixed to the pointer 12 slides back and forth as the pointer is moved over an arc-shaped core about which is disposed a potentiometer winding. Each end of the said winding being of different potential, it follows that the center is of zero potential. A repeater or indicator 15, which may be located at some distance, has one lead connected, for example, to the pointer 12, and another lead to the center of the potentiometer winding, the point of zero potential. When the pointer is at the zero position, there will be no reading on the instrument or repeater 15, but any other position of the pointer will be accompanied by a corresponding deflection of the repeater.

The operation of the device is as follows: when the body, for example, an airplane in which the device is installed, is set in motion about the vertical axis, which in the embodiment as shown is the sensitivity axis of the gyro, the gyro will begin to precess, that is, it will rotate about the precession axis 3, 3 against the tension of springs 6, 6. This turning of the shaft 3, 3 will be communicated in a like degree directly to segment 10, since it is fixed to the shaft, and this displacement in magnitude and direction corresponds to the angular velocity of the said angular movement. If there were no magnet system, eddy current member 9 would also turn with the shaft by virtue of its connection through sleeve 7. However, with the magnet system, as soon as member 9 starts to rotate with the shaft, this relative motion to the magnet will generate eddy currents in said member, and these eddy currents will exert a strong braking effect, preventing free movement of the member in either direction. This braking effect will not be communicated back in any appreciable degree to the precession shaft, since the torsional flexibility of the sleeve 7 will permit it to readily twist under the influence of the braking effect on the disc. There thus results, whenever precession takes place, a relative displacement between segment 10 and disc 9, since the former moves directly with shaft rotation and the latter is prevented from so doing by the braking effect of the eddy currents.

It should be borne in mind that the braking effect of the eddy currents on the disc is dynamic, which is to say that it can only exist when the disc is in motion, and that it increases as the motion tends to increase. Thus the disc will lag behind any rotational motion of the precession shaft (angular acceleration of the aircraft), but if and when the shaft turns to a certain angle and then comes to rest and retains such angle, the disc will gradually move over to its corresponding position. In other words, the eddy currents will not stop motion of the disc entirely, but will inhibit any sudden or fast motion.

The pointer 12 has thus at the same time two values impressed on it, to wit, the angular displacement from the normal position of the precession shaft (which corresponds to angular speed of the aircraft), and the rotational speed of the precession shaft (which corresponds to angular acceleration of the aircraft). Assume that the magnet is deenergized and that the precession shaft, as a result of the aircraft making a turn for instance, rotates to a new angle and holds it. This holding to a certain displacement angle by the shaft signifies that the angular speed of the aircraft is uniform, that is, not accelerated. Both segment 10 and eddy current disc 9 will be displaced angularly the same amount as the shaft, and they, being connected together and to the measuring member 12 by the connecting member or link 11, will move the measuring member over to an indicating position, the value of which indicates the speed of the angular movement. As a matter of fact, in this instance, it will make no great difference whether the magnet is energized or not, as even if energized, since the shaft is holding a certain displacement position, the disc would gradually move over and take the corresponding position. Now consider the magnet in normal operating condition, that is energized, and the precession

shaft not only displaced from its normal position, but moving. The shaft displacement signifies angular speed of the aircraft, and the shaft motion angular acceleration of the aircraft. Segment **10** will faithfully follow the shaft as before, being locked to it, but eddy current member **9** cannot follow the active motion of the shaft, since it is prevented from so doing by the braking effect of the eddy currents generated in the disc by the magnet. The segment and the disc will thus be subjected to a displacement one with the other, since the disc will lag behind the segment, and this lagging will cause the segment to move the pointer in a greater degree than it would otherwise do. That part of the total indicated value registered by the measuring member due to the displacement between segment and disc will be an index to the angular acceleration of the aircraft, and that part due to the concerted motion of segment and disc will be an index of its angular speed. There are thus two values registered by the device, one superimposed upon the other.

There is thus provided novel means for the accurate determination of the angular acceleration of bodies, said means constituting a space saving and vibration-proof instrument which is particularly suited for measuring the angular acceleration of aircraft.

KURT SCHULZE.

PUBLISHED

JUNE 1, 1943.

BY A. P. C.

K. SCHULZE

MEANS FOR DETERMINING THE ANGULAR ACCELERATION OF AIRCRAFT

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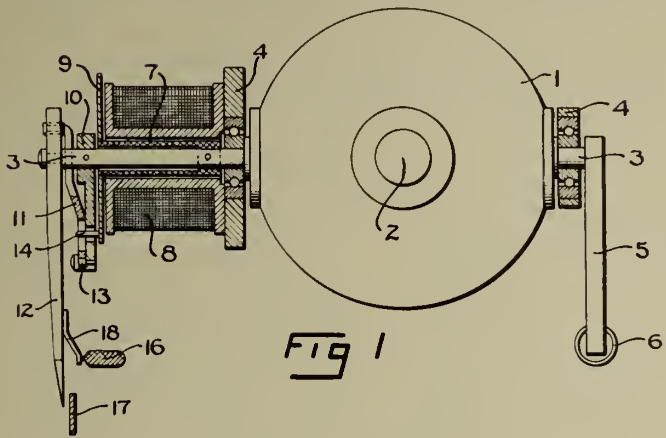

Fig 1

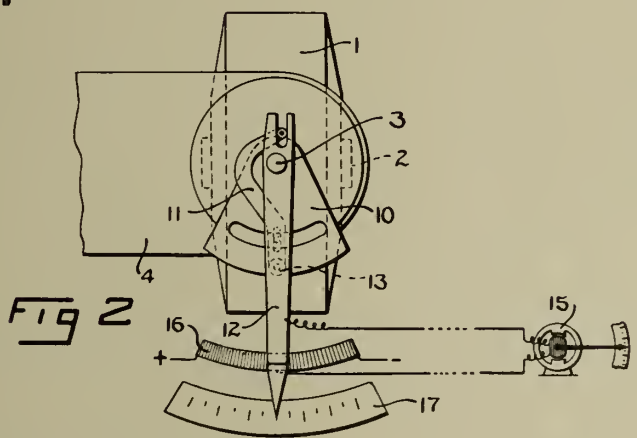

Fig 2

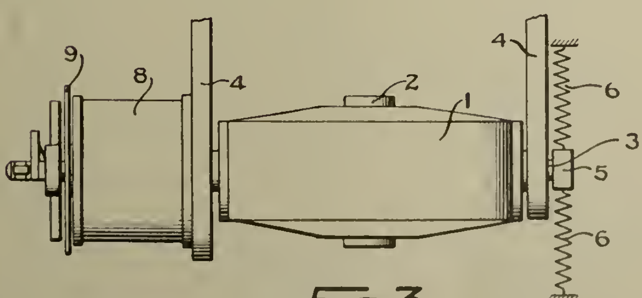

Fig 3

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ALIEN PROPERTY CUSTODIAN

AIR-SCREW PROPELLER MOUNTINGS

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Application filed January 5, 1942

My invention relates to the elastic mounting of aircraft propellers on their driving shafts.

Elastic propeller mountings avoid or reduce the transmission of vibrations resulting from periodic torques from the power shaft to the propeller blades. It is also of advantage to give the propeller a limited amount of freedom to tilt its geometrical axis with respect to the power shaft axis, which avoids or reduces the stresses resulting from the propeller blades passing in front of a wing or any other obstruction to the flow of air, from a lack of balance between the blades, from the gyroscopic torques caused by the oscillations of the power shaft axis, particularly in the case of elastically mounted engines which generally oscillate more or less conically about a natural or fixed axis, etc. With an appropriate elastic mounting of the propeller, these oscillations of the geometrical axis of the power shaft do not affect or affect only slightly the axis of the propeller.

My invention has for its object an elastic mounting which possesses a high mechanical strength while permitting the propeller to oscillate in any direction with respect to the power shaft axis.

Another object of my invention is to provide an elastic propeller mounting which may be applied to variable-pitch propellers without requiring an additional radial space with respect to the space necessitated by the pitch controlling device.

Still another object of my invention is an elastic mounting wherein the elastic members ensuring the transmission of the power torque and of the axial effort of the propeller, as well as the elastic members limiting the oscillations or tilting motions of the propeller with respect to the power shaft, are disposed externally of the propeller hub, substantially in the vicinity of the average plane of the propeller blades and in the spaces between the successive blades.

Still a further object of my invention is an elastic propeller mounting wherein the propeller hub is comprised between two star-shaped plates to which the elastic members are attached, the radial arms of the plates projecting between the propeller blades, while the latter are disposed in the spaces between the successive radial arms of the plates, and the corresponding arms of the two plates being connected with each other either directly or by transverse stays passing between the propeller blades.

My mounting preferably comprises a spherical elastic member carried by the power shaft and supporting the propeller hub, said member forming merely a center for the propeller without materially ensuring the transmission of torque or of axial effort. Said member is preferably located in the vicinity of the center of gravity of the propeller.

My mounting also comprises abutments adapted to limit the oscillations or tilting motions of the propeller with respect to the power shaft, said abutments being inactive or almost inactive in normal operation (cruising conditions, for instance), but preventing the too large displacements resulting for instance from the sudden application of the full power of the engine, from rough atmospheric conditions, etc.

In the annexed drawings:

Fig. 1 is a front view, with partial section along line I—I of Fig. 2, showing a diagrammatical embodiment of my invention.

Fig. 2 is a longitudinal section thereof along line II—II of Fig. 1.

Fig. 3 is a front view of a mounting according to my invention, with partial section taken along line III—III of Fig. 4.

Fig. 4 is a longitudinal section taken along line IV—IV of Fig. 3.

Fig. 5 is a front view of the propeller hub used in the mounting of Figs. 3 and 4.

Fig. 6 is a longitudinal section thereof taken along line VI—VI of Fig. 5.

Fig. 7 is a sectional view to an enlarged scale of a torque transmitting member.

Fig. 8 is a plan view thereof with partial section.

Fig. 9 is a front view with partial section showing the box adapted to cooperate with a pair of torque transmitting members.

Fig. 10 is a plan view thereof with partial section along line X—X (Fig. 9).

Fig. 11 is a partial cross-section of a torque transmitting device provided with abutments to limit the relative angular displacements.

Fig. 12 is a partial cross-section illustrating a modification.

Fig. 13 is a front view of a second embodiment of my invention, with partial section taken along line XIII—XIII of Fig. 15. In this figure the torque is supposedly applied by the power shaft to the propeller.

Fig. 14 is a partial section showing the parts at the no-load position.

Fig. 15 is a longitudinal section taken along line XV—XV of Fig. 13.

Fig. 16 is a longitudinal section illustrating a third embodiment of my invention.

Fig. 17 is a corresponding plan view with parts in section along line XVII—XVII of Fig. 16.

Fig. 18 is a partial front view illustrating a modification of the mounting of Figs. 13 to 15.

Fig. 19 is a section along line XIX—XIX of Fig. 18.

Fig. 20 is a diagrammatic section along line XX—XX of Fig. 18.

Fig. 21 shows another embodiment of my invention in general longitudinal section.

Fig. 22 is a partial detailed view thereof.

Fig. 23 is a cross section taken along line XXIII—XXIII of Fig. 22.

Fig. 24 illustrates a minor modification.

Fig. 25 is a partial front view with parts in section, showing a further embodiment of my invention.

Fig. 26 is a section taken along line XVI—XVI of Fig. 25.

In Figs. 1 and 2, which are only given to illustrate diagrammatically the main features of my invention, 1 designates an engine of any description, for instance an internal combustion engine. 2 is the power shaft thereof whereon there is mounted an annular rubber member 3 carrying a hub 4 supporting three propeller blades 5.

Each side of hub 4 shaft 2 carries star-shaped plates 6, each plate having three arms disposed between the successive propeller blades 5, as clearly shown in Fig. 1, while the blades project in the spaces between the successive arms.

The corresponding arms of plates 6 are connected with each other by means of arcuate members 7 passing between the successive blades 5. And the inner face of each member 7 is elastically connected with the outer cylindrical face of hub 4 by a layer 8 of rubber. This layer projects slightly beyond the ends of member 7 so as to form a sort of buffer 9 adapted to cooperate with the bases of blades 5 to limit the angular displacement of hub 4 with respect to plates 6.

The inner faces of plates 6 also carry rubber blocks 10 adapted to co-act with the lateral faces of hub 4 to limit the tilting motion of the geometrical axis of hub 4 with respect to the axis of shaft 2. At the idle position blocks 10 are spaced from hub 4 as shown in Fig. 2. Blocks 10 are arranged between the propeller blades as indicated in Fig. 1.

The propeller assembly also comprises a pitch controlling device generally referenced 11 of the electric type and which has been supposedly removed in Fig. 1. This device will not be described since it forms no part of my invention. It is fixed to hub 4 by means of ribs 12 projecting therefrom and is housed within the conventional spinner 13.

Member 3 supports hub 4 on shaft 2, while permitting same to oscillate elastically in any direction. The rubber layers 8 transmit the power torque from plates 6 to hub 4. They also transmit the axial pull of the propeller blades from hub 4 to plates 6 mechanically connected with each other by means of members 7. Buffers 9 and blocks 10 limit the displacement of hub 4. They are normally inactive.

Owing to the disposition of the rubber members between the successive blades, the axial length or thickness of the propeller assembly is not substantially increased with respect to a rigid mounting. The pitch-controlling device 11 is fixed to the propeller hub in the usual manner and needs no universal joint or the like between its internal gearing and the blades. The diameter of the propeller spinner is still determined by the inner ends of the active portion of the blades and is not enlarged by the elastic members.

In the construction shown in Figs. 3 and 4, plates 6 are carried by two hubs 14 keyed in contacting relation on shaft 2. The propeller centering member is in two parts, each comprising an inner ring 15 and an outer ring 16 elastically connected with each other by a layer 3 of rubber of substantially spherical form, as shown in Fig. 4. Rings 15 are clamped on the front hub 14 while rings 16 are fixed on the inner face of the propeller hub 4 between an annular rib 17 and a screwed ring 18.

Figs. 5 and 6 clearly show the construction of the propeller hub 4 which comprises radial housings 19 for the blade ends, connected together by U-shaped portions having spaced wings 20.

The torque transmitting members (Figs. 7 and 8) comprise a mass of rubber 21 interposed between stays 22 connecting plates 6 and boxes 23 fixed to the wings 20 of hub 4. The boxes 23 are U-shaped in section, as shown in Fig. 3 with the open face disposed outwardly with respect to hub 4. The bottom of each box is preferably rounded, as indicated in 24 (Fig. 7), concentrically with respect to the rubber layer 3 (Fig. 4); the corresponding stay 22 is formed in accordance. Stays 22 are fixed to plates 6 by means of nuts 25.

Boxes 23 are fixed to wings 20 by means of cradle members 26 (Figs. 9 and 10) comprising housings 27 to receive the said boxes which are longitudinally retained by their flanged ends 28 (Fig. 8). Members 26 (Figs. 9 and 10) are also provided with lateral projections 29 adapted to fit into recesses 29*a* of wings 20 (Fig. 5) and with wings 30 (Fig. 9) fixed to wings 20 by means of screws or bolts 31 (Fig. 3). Members 26 also have holes 32 (Fig. 9) through which are passed bolts 33 (Figs. 3 and 4) driven through wings 20.

The torque transmitting members described may transmit the longitudinally pull. They may form by themselves abutments limiting angular displacements of hub 4 with respect to plates 6 about the axis of shaft 2, or such abutments may be provided in addition to the said members as shown in Figs. 11 and 12.

In Fig. 11 an arcuate member 34 is fixed to two successive stays 22 and it carries a support 35 supporting two rubber blocks 36 and 37 adapted to cooperate with the walls of the housings 27 (Fig. 9) of member 26. At the no-load position (Fig. 11) block 36 contacts member 26 while block 37 is spaced therefrom. Under normal load the two blocks are equally spaced from member 26 and in the case of overload block 37 abuts against the latter. Support 35 may be arranged adjustable, as shown, by being pivoted at 35*a* and retained by an adjustable screw 35*b*.

In Fig. 12 rubber blocks 36 and 37 are carried by a member 38 which is adjusted by means of an eccentric 39 keyed on a shaft 40.

The propeller assembly also comprise rubber blocks 10 glued on the outer faces of wings 20 and adapted to form abutments in co-operation with the inner faces of plates 6 (Fig. 4). Blocks 10 preferably contact plates 6 under light pressure, as shown. They elastically prevent too large oscillations of the axis of hub 4 with respect to shaft 2 and they transmit, at least in part, the propeller pull from hub 4 to plates 6.

The propeller assembly further comprises a pitch control gear which is not illustrated. Fig. 3 shows the bearings 41 for the controlling shafts

which carry worm gears in mesh with gear wheels **42** (Fig. 4) provided at the inner ends of blades **5**. The controlling shafts, not shown, are driven by an electric motor carried by a support partially shown at **43** (Fig. 4).

In the construction shown in Figs. 13 to 14 the elastic members adapted to transmit the power torque and the propeller pull are formed of masses of rubber **8** comprises between a plate **7** fixed to plates **6** by means of bolts **44**, and a plate **45** fixed by bolts **46** to wings **20** of hub **4**. The rubber extends radially along the outer faces of wings **20** so as to form lateral blocks **10** which do not contact plates **6** or only contact same under light pressure.

The rubber interposed between plates **7** and **45** projects rearwardly (with respect to the direction of rotation of the propeller) forming a sort of block **9** which at the no-load position (Fig. 14) abuts against an abutment **47** fixed to wings **20**. Under normal load block **9** is spaced from abutment **47**.

The rubber parts **8**, **9** and **10** substantially operate as described with reference to Figs. 1 and 2.

In the construction shown in Figs. 16 and 17 the arms of plates **6** are brought into contact between the successive blades and the elastic member forming a connection between the plates and the propeller hub is formed of a ring **48** of rubber surrounding the ends of the arms of plates **6**, the said ring being housed within a recess **49** provided in a member **50** connecting two successive blade housings **19**. The mass **48** of rubber is preferably glued between two armatures **51**, void spaces **52** and **53** being provided to facilitate rubber expansion and to lower the elastic reaction under normal loads. When one of these spaces disappears, for instance due to a high increase of the power torque, the elastic reaction increases and the elastic member operates as a limiting abutment to prevent too large oscillations.

The construction shown in Figs. 18 to 20 is substantially similar to Figs. 13 and 15, but in the propeller hub the blade housings **19** are connected with each other by a T-shaped portion **54** in lieu of wings **20** of Figs. 5 and 6. The mass of rubber **8—10** is V-shaped as shown, plates **6** being slightly conical. The outer plate **7** is here strong enough to form a stay between plates **6**.

When the elastic members adapted to transmit the power torque and the propeller pull are appropriately disposed, the centering member **3** may be dispensed with. It is then necessary that the elastic members only permit the propeller hub to move substantially spherically about a center coincident with the center of gravity thereof, the degree of freedom in any other direction being very limited. This could be achieved, in the mounting of Figs. 3 and 4 with a limited thickness of rubber between each stay **22** and the bottom of the corresponding box **23**, the bottom and the corresponding face of the stay being curved as shown to a radius from the center of gravity of the propeller.

Figs. 21 to 24 show a mounting which is generally similar to the mounting of Figs. 3 and 4. In this mounting the stays **22** connecting the two plates **6** are curved concentrically to the center of gravity G. They are surrounded by a cylindrical (or more exactly toric) mass of rubber **21** disposed within a box **23** passed through the propeller hub **4**. In Figs. 21 and 22 plates **6** are provided with rubber blocks **10** forming lateral abutments. No centering member is provided, but owing to the shape of stays **22**, the propeller hub oscillates substantially spherically about G.

In order to obtain a sufficient elasticity about the axis of shaft **2** without having to use a very soft rubber which would result in a too large radial freedom, void spaces **55** are left within box **23** to permit free lateral expansion of rubber **21** (Fig. 23).

The mounting of Fig. 24 only differ from Fig. 22 by the omission of blocks **10** the role of which is played by the ends of the mass of rubber **21** which project beyond the ends of boxes **23** and form buffers or abutments in cooperation with plates **6**, as indicated at **56**.

In the mounting of Figs. 25 and 26 the toric boxes **23** instead of being transverse with respect to plates **6**, are disposed in the average plane of the blades **5**. They are supported by plates **6** which are slightly conical, and are fixed thereto by a cover **57**. Stays **22** are fixed to lugs **58** carried by the propeller hub **4**.

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PUBLISHED

JUNE 1, 1943.

BY A. P. C.

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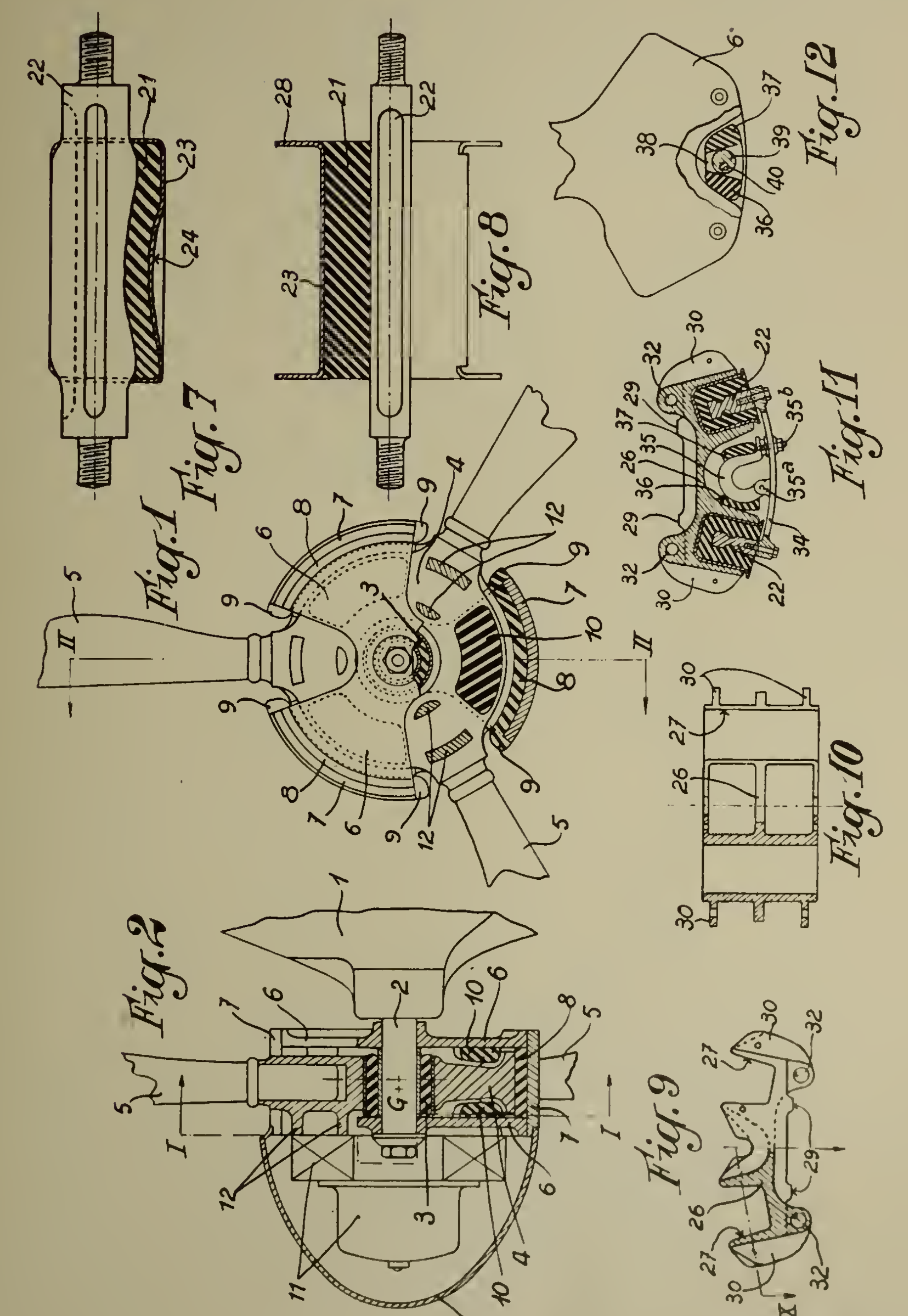
AIR-SCREW PROPELLER MOUNTINGS

Filed Jan. 5 1942

Serial No. 425,692

6 Sheets-Sheet 1



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AIR-SCREW PROPELLER MOUNTINGS

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6 Sheets-Sheet 2

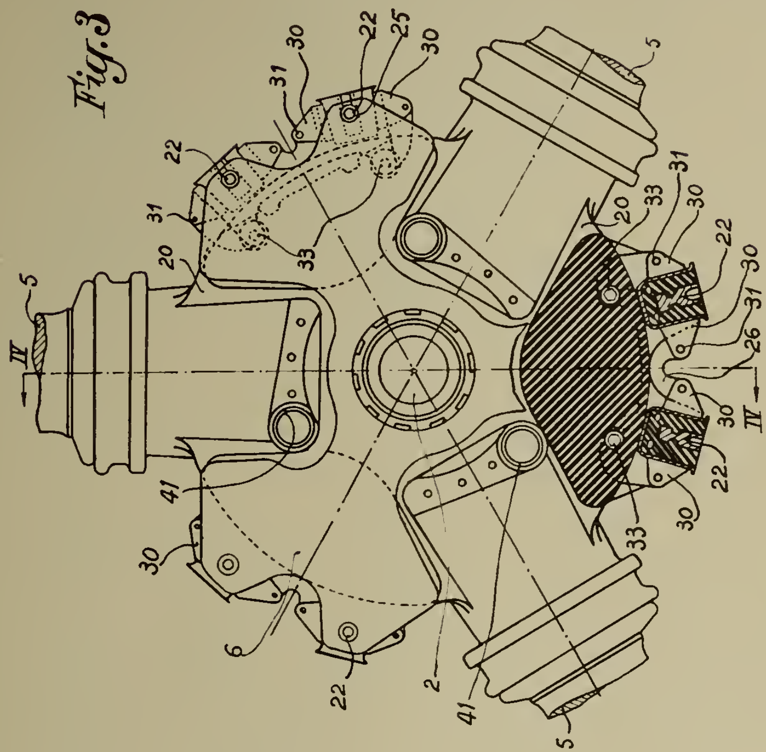

Fig. 3

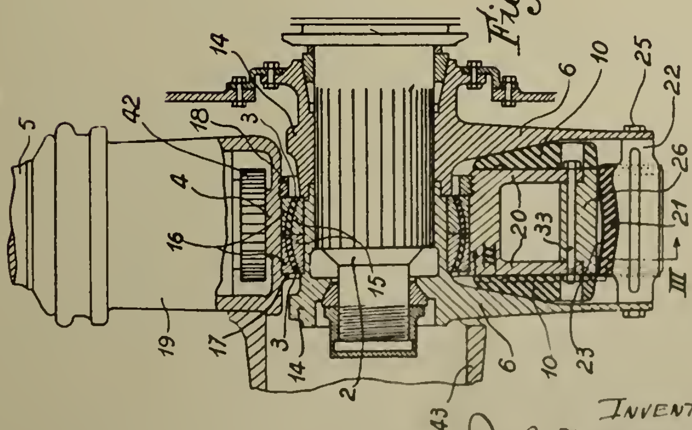

Fig. 4

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AIR-SCREW PROPELLER MOUNTINGS
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Serial No.
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6 Sheets-Sheet 3

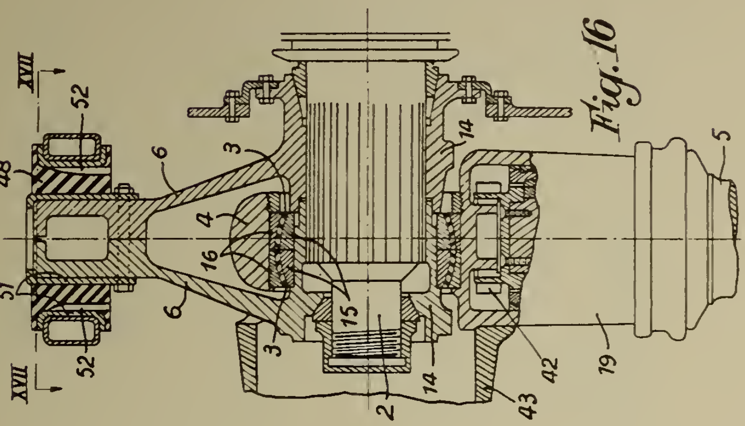

Fig. 16

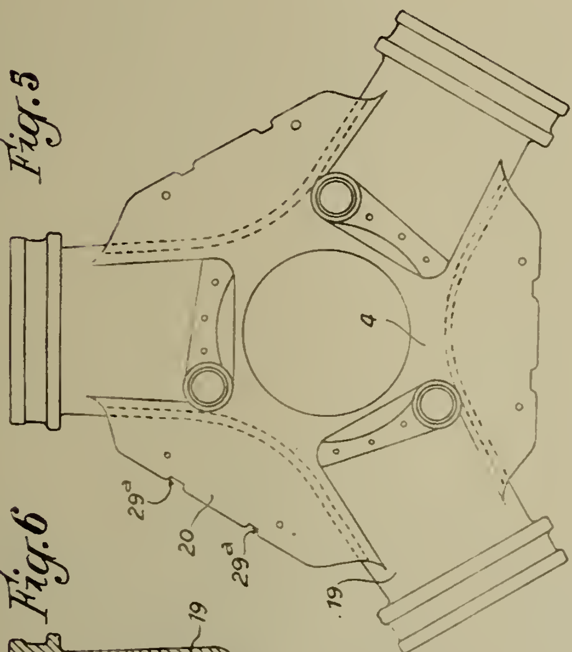

Fig. 5

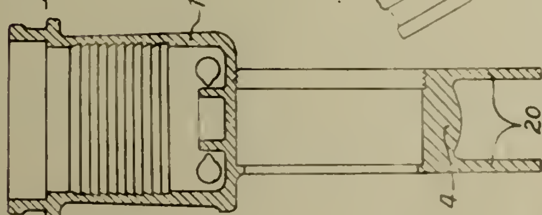

Fig. 6

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Serial No.
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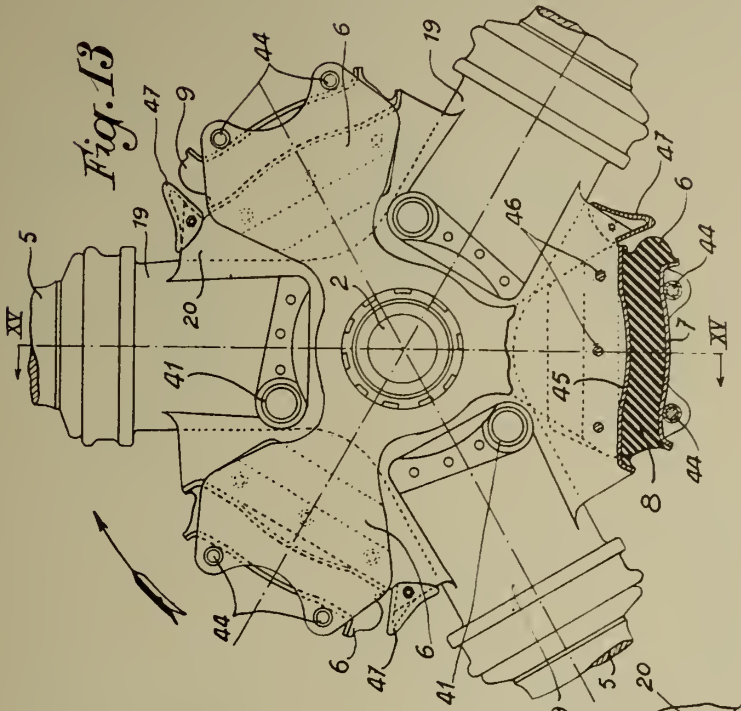

Fig. 13

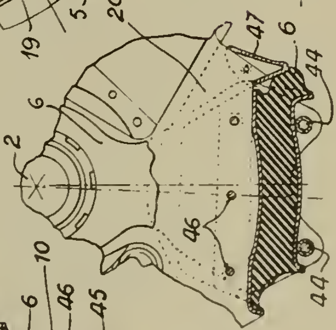

Fig. 14

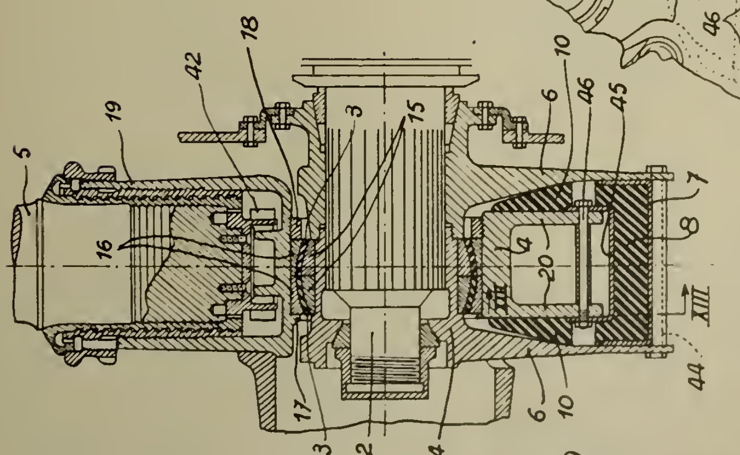

Fig. 15

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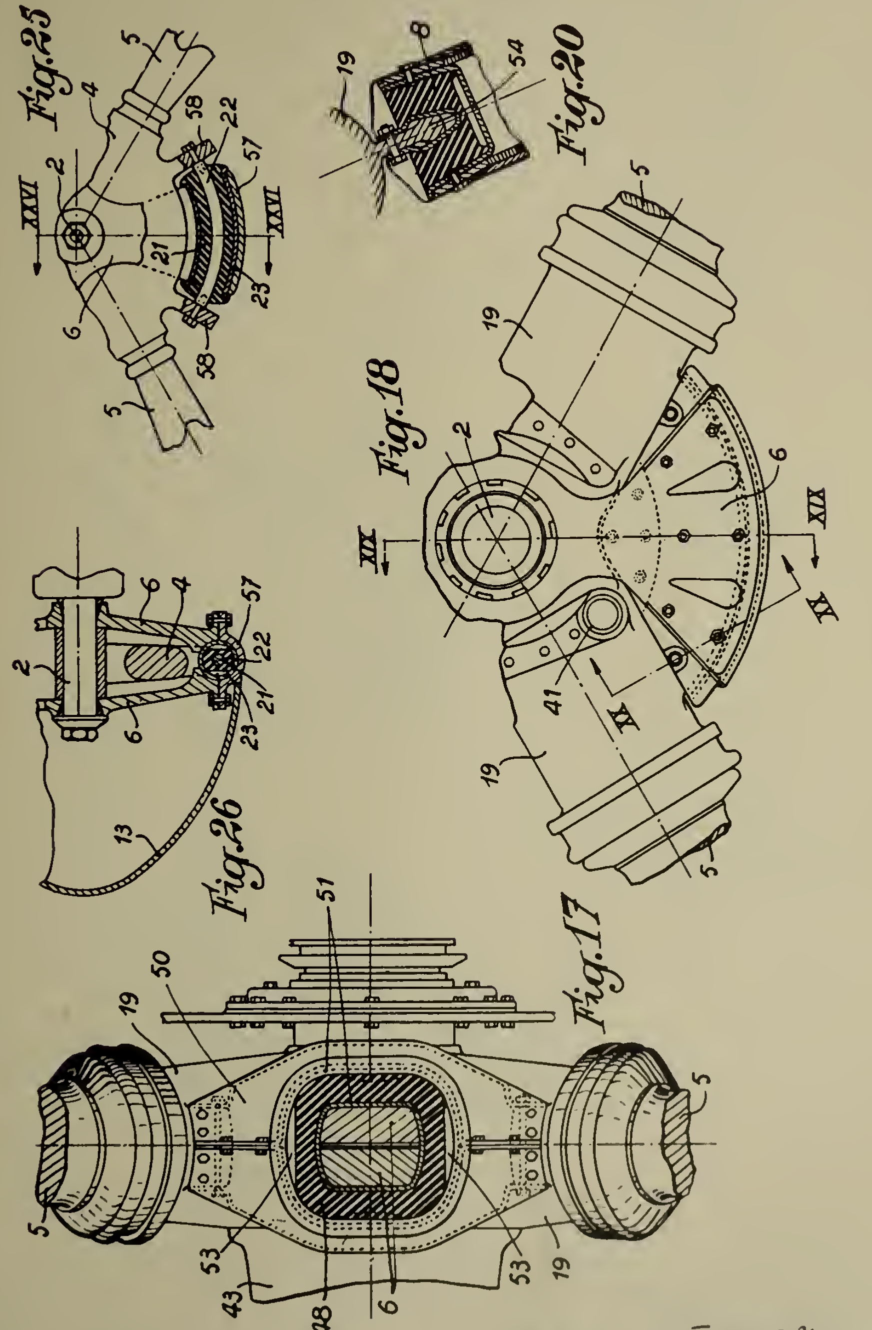
6 Sheets–Sheet 5



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Serial No. 425,692

6 Sheets-Sheet 6

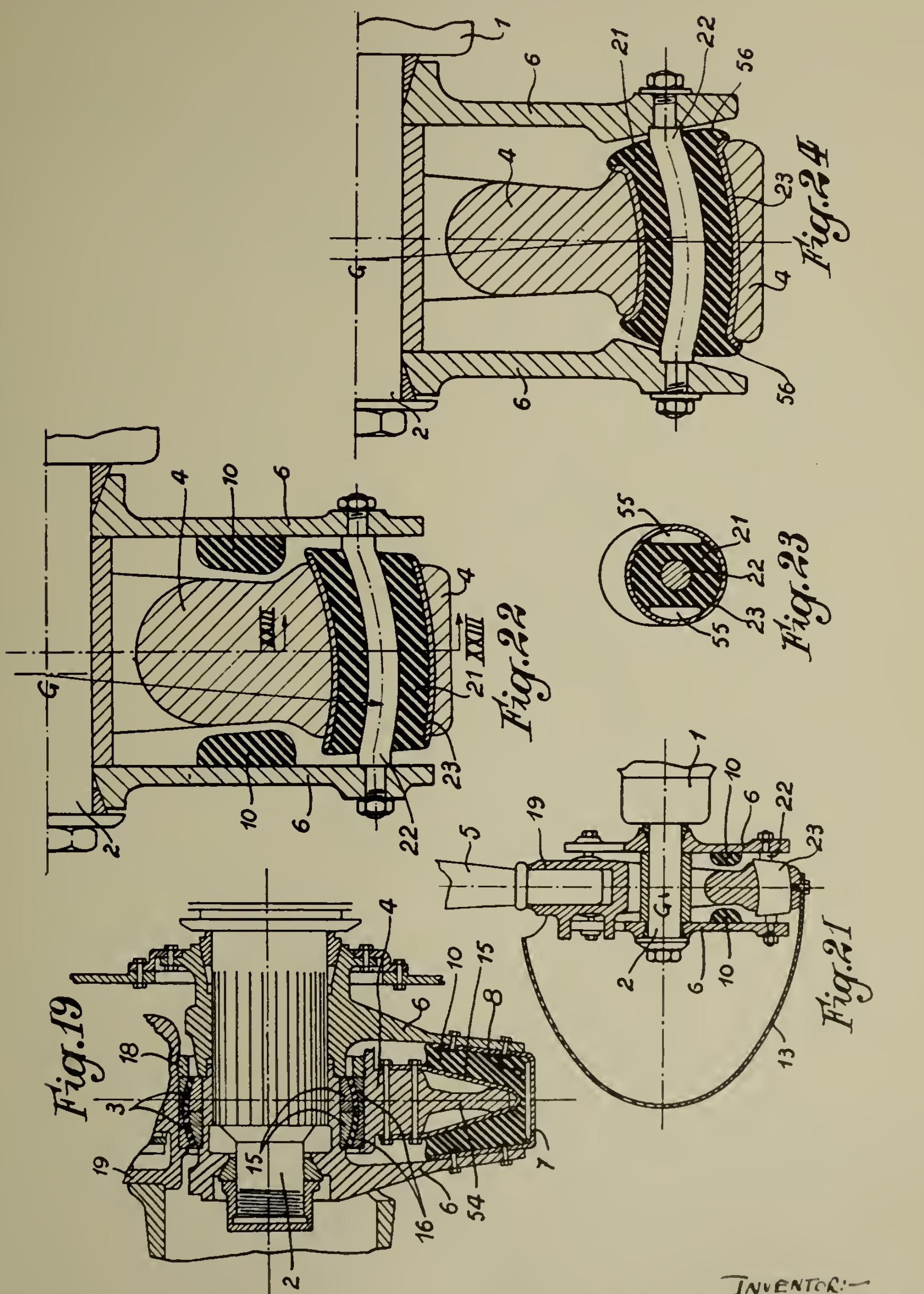

Fig. 19 Fig. 21 Fig. 22 Fig. 23 Fig. 24

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Serial No. 426,244

ALIEN PROPERTY CUSTODIAN

MOLDS AND IN PARTICULAR TO FOUNDRY CORES AND TO THEIR MANUFACTURE

Georges Passelecq, Paris, and Alexis Séménoff, Villers St.-Paul, France; vested in the Alien Property Custodian

No Drawing. Application filed January 9, 1942

The manufacture of molds and more particularly foundry cores presents, among others, a double problem to be solved; on the one hand, the masses used for this manufacture must have sufficient cohesion to lend themselves to molding; on the other hand, it is necessary that they be sufficiently porous to allow, when the molten metal is poured, the escape of gases generated by the molten metal and by the binders utilized in the core. This double problem offers greater difficulties in so far as foundry cores are concerned because of the position these are to occupy in the midst of the metal.

Silico-argillous sands ordinarily utilized as foundry sands possess by themselves an agglomerating capacity which would allow their utilization for the fabrication of foundry cores, without the aid of any binder. But experience has shown that cores thus constituted present an insufficient porosity. It is consequently customary to add to the foundry sand, for this fabrication, an important quantity of silica the purpose of which is to increase the porosity and which may attain from 70 to 85% of the mixture. The addition of such a high proportion of silica necessitates, for the agglomerating process, the intervention of binders, usually constituted by organic substances such as molasses, the residual lyes of sulphited cellulose, and to which it is generally necessary to add an important proportion of linseed oil, which by oxidation gives the agglomerate the desired consistency.

The main object of the present invention is a making process of foundry cores which particularly allows to do away with the necessity of having recourse to linseed oil or to other organic binders, while ensuring nevertheless a suitable cohesion and porosity of the cores. The invention also concerns the extension of this process to the manufacture of foundry molds properly speaking, and it comprises, as new industrial products, molds and cores fabricated by this process. The manufacturing process of cores according to the invention, consists essentially in constituting a mixture of foundry sand, binder or agglomerating agent and wetting emulsioning agent, it being possible for the foundry sand itself to contain the binder, after which the cores are formed by passage through a draw plate or by molding or pouring into molds or core boxes, according to the greater or lesser degree of fluidity of the paste obtained.

Thanks to the wetting-emulsioning agent incorporated to the sand, the latter is perfectly wet and the occluded air remains in the interior of the mass, thus producing multiple pores. It is possible to use to this effect one of the many products known in industry for their wetting and emulsioning properties, such as for instance: isopropyl (or butyl), naphthalene sulphonate of soda (known commercially as "Brecolane") or also the products known commercially under the denomination of "Diastersols NDS," sulphonated lauric alcohols or derivatives of formaline condensed with sulphonated naphthalenes or even natural products.

The process, which is the object of the invention may be applied, particularly, to the constitution of foundry cores using initially ordinary silico-argillous foundry sands. In this case, the very sand containing its binder, which is the clay, it is sufficient to confer to it the desired porosity by wetting it with a solution, or aqueous suspension, of the wetting-emulsioning agent, known as "Brecolane." It is possible for example, to add to the sand an aqueous solution, saturated at 10%, of this wetting agent, in a proportion of 10 to 15% of this solution with respect to the weight of the sand. After the mixture has been through a mixer, a paste is obtained which may be put through a draw plate or which may be used to fill more or less complicated core molds. The cylinders or cores thus formed are dried in a drying-room at a temperature of at least 120° C. Argillous cores are at last obtained having a good resistance for the use for which they are to serve and the apparent density of which may vary from 1.20 to 1.75.

According to the invention, the process may also be applied to the fabrication of cores by using initially sands which do not have by themselves practically any agglomerating capacity, such as sands constituted by more or less pure silica. In this case, in addition to the wetting agent, it is advisable to add a binder to the silicious sand. To this end, it is possible to have recourse, in particular, to sodium silicate in which case care must be taken to incorporate to the mixture a substance capable of decomposing the sodium silicate thereby giving rise to the formation of nascent silica having the power to ensure the setting of the mixture. The proportion of binder incorporated to the mixture may vary according to the degree of plasticity or liquefaction desired. If, for instance, a solution at 36° Bé. of commercial sodium silicate is used, this proportion may vary from 5 to 20% by weight of the mixture composed of the other materials.

The reaction of decomposition of the sodium silicate may be, notably, as it is known "per se,"

a catalytic reaction, in which case the substance which is added to the mixture to obtain this decomposition plays the unique or principal part of a catalyser. To that purpose, it is possible to use such substances as, for instance, fluosilicates, fluotitanates, fluotungstates, fluozirconates of sodium or of potassium. The quantity of catalyser for setting may vary with the setting speed desired: in general, a proportion of sodium fluosilicate of 2 to 15% with respect to the weight of the sodium silicate used will be employed, thus obtaining a setting time varying from 40 to 60 minutes. To allow the use of the smallest possible quantity of catalyser, it seems desirable that the ratio

$$\frac{SiO_2}{Na_2O}$$

of the sodium silicate be at least equal to 3,2. However, it is preferable that the ratio do not exceed the value of 3,35 so as not to hinder the reaction giving rise to the formation of nascent silica.

A real stoicheiometric reaction may also be used by causing the flocculation of nascent silica by any reacting agent having a pH lower than that of the sodium silicate solution or containing or capable of liberating a molecule of free acid the acidity of which is at least equal to that of the silica. Along the same line of thought, it is possible to use, in order to obtain this reaction, bicarbonates or tricarbonates which, in the presence of water, give rise to free carbonic acid, or again, a sulphate, such as for instance, aluminium sulphate which, in hydrolysing, produces sulphuric acid. It is also possible to use a sulphide capable of liberating, by hydrolysis, hydrogen sulphide which then acts as a weak acid, or an organic compound such as ortho or paratoluene sulphochloride which produces, by hydrolysis, one or several acids. Tests effected to this day seem to have revealed that, in the case of a reaction of stoicheiometric decomposition, the ratio

$$\frac{SiO_2}{Na_2O}$$

of the sodium silicate may be lowered to about 2,5.

The quantity of wetting agent may vary with the greater or lesser degree of porosity which it is desired to obtain for the final agglomerate; if, for instance, the wetting agent known as "Diastersols NDS" or the one known as "Brécolane" be utilized, the proportion of this substance used may be chosen between 2 and 5% with respect to the weight of the sodium silicate.

It is preferable, in practical applications of the invention, to effect a thorough mixture of the catalyser or substance for setting and of the wetting agent with an equal weight of sand, and then, to add the rest of the sand. After mixing in a mixer and addition of sodium silicate a sand is obtained suitable for the fabrication of cores, either by the usual method, or by vibrating for a short time. If the proportion of sodium silicate solution is sufficiently high, the mass obtained is sufficiently fluid to be poured, notably in formed molds, which allows the construction of even very complex cores, the setting taking place due to the catalysing action of the incorporated fluosilicate. Cores thus obtained have a good resistance and are very porous, their apparent density varying, for instance, from 1,20 to 1,60.

When it is desired to constitute cores which must have special qualities of mechanical resistance and at the same time a brittleness after molding sufficiently great to permit an easy removing of the sand—for example in the case of very long and very thin cores which cannot be upheld along their length, such as those used in the manufacture of heating radiators—it is possible, in accordance with the present invention, at the same time as a certain quantity of sodium silicate is incorporated in order to ensure that the agglomerate will have the desired resistance, to add to the mixture a substance which, while not possessing any property appreciably harmful to the agglomeration, or even possessing by itself a certain agglomerating power, can be destroyed by the heat generated when the molten metal is poured. Substances which are especially suitable for this purpose are the polyalcohols and notably glycols and glycerine. As substitutes for such substances, it is also possible to use saw dust, bales of rice or other cereals, etc. The addition of substances of this nature to the mixture to be agglomerated may also prove advantageous in those cases where, without specifically seeking to obtain a high resistance of the cores, it is profitable because of the shape of the latter, to seek a greater facility for removing the sand after molding.

As has already been said, the process, according to the invention, may also be applied to the construction of molds, this application being obtained under the same conditions as those in the fabrication of cores. In particular, in the case where the mass to be molded is constituted by a mixture of sand, of sodium silicate, of fluosilicate and of wetting-emulsioning agents, it is possible to form the molds by usual methods, by vibrating or by pouring this mixture on to the pattern, which allows the suppression of a great number of delicate operations usually necessary in the molding of foundry parts: in particular an economy of specialized labor and of time is obtained and the operations of drying and of baking are eliminated.

Moreover, it is interesting to note that, as a result of the absence of organic binders, the gaseous emanation proceeding from the core and the mold is practically eliminated, which condition offers a notable improvement from the point of view of handling (facility, cleanliness, shop hygiene).

In order to diminish the risk of eventual sticking of the mass to be molded (cores or molds) to the patterns or to the core boxes, it is advisable to apply on to these patterns or boxes a rubbered paint such as, for instance, that found on the market.

Hereunder are examples of carrying out of the invention which are given by way of indication.

Example 1

To 200 parts of argillous foundry sand are added 25 parts of an aqueous solution saturated with the wetting agent "Brecolane" (10%). A thorough mixing is effected in an emulsioning machine. The mixture is molded and dried at 120° C. by gradually raising the temperature.

Example 2

	Parts
Siliceous foundry sand	1
Sodium fluosilicate	1
Wetting agent "Diastersol NDS"	1

are thoroughly mixed.

The mixture is added to 200 parts of siliceous foundry sand.

When about to be used, 20 parts of sodium silicate are thoroughly incorporated. The mixture is molded, and the setting allowed to take place.

Example 3

	Parts
Siliceous foundry sand	1
Sodium fluosilicate	1
Wetting agent Primatex NLW	1

are thoroughly mixed.

This mixture is added to 200 parts of siliceous foundry sand.

When about to be used, 20 parts of sodium silicate are incorporated. The mixture is molded, and the setting allowed to take place.

Example 4

	Parts
Siliceous foundry sand	1
Sodium fluozirconate	1
Saponin	1

are thoroughly mixed.

This mixture is added to 200 parts of siliceous foundry sand.

When about to be used, 20 parts of sodium silicate are thoroughly incorporated. The mixture is molded, and the setting allowed to take place.

Example 5

100 parts by weight of siliceous foundry sand are thoroughly mixed with 0.36 part by weight of sodium fluosilicate, 0.12 part by weight of the dispersing and wetting agent "Brecolane NCK" and 0.12 part by weight of bentonite or colloidal clay. Then 6 parts by weight of sodium silicate at 36° Bé were added to this mixture, after which the cores were molded under the usual conditions and allowed to set.

Example 6

	Parts by weight
Siliceous foundry sand	100
Barium sulphide at 80%	0.25
"Diastersol NDS"	0.12

are thoroughly mixed. Then 6 parts by weight of sodium silicate at 36° Bé are added to this mixture, after which the cores are molded. The setting takes about three times as long as if sodium fluosilicate were used as catalyzer.

Example 7

	Parts by weight
Siliceous sand	100
Paratoluene sulphochloride	0.03
"Diastersol NDS"	0.12

are thoroughly mixed; then 6 parts by weight of sodium silicate are added to this mixture and the cores are molded in the usual fashion. The setting takes place at substantially the same speed as if 0.36 part by weight of sodium fluosilicate were used as catalyser. If an immediate setting is desired, it is advisable to use a proportion of paratoluene-sulphochloride from four to five times as great as that indicated hereabove.

GEORGES PASSELECQ.
ALEXIS SÉMÉNOFF.

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ALIEN PROPERTY CUSTODIAN

MANUFACTURE OF MOLDED PRODUCTS

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No Drawing. Application filed January 9, 1942

The idea has already been had of manufacturing mastics and cements called "antiacid", by using as an agglomerating agent sodium silicate in the presence of a catalyser causing the setting of the latter, such as, for instance, sodium fluosilicate, and a wetting agent. The sodium fluosilicate causes, as is well known, the decomposition of the sodium silicate with the formation of nascent silica and it is the latter which, once freed, combines with the silicious substances contained in the inactive powders utilized in the manufacture of these cements and mastics and ensures the agglomerating one to another of the various particles of matter. The wetting agent facilitates the preparation of the pastes, increases their fluidity and improves the adherence of finished cements and mastics.

These cements and mastics, which comprise, in practice, a high proportion of sodium silicate, are applied by means of a spatula or a trowel.

Now, it has been found, according to the present invention, that mixtures of this nature could be applied to the manufacture of molded products of high quality starting from pulverulent substances of diverse natures, by using particularly small proportions of sodium silicate. The invention ensures, notably, the obtention of molded products which have a high percentage of useful agglomerated substances and at the same time a strong reciprocal binding of their constituent particles. It allows, moreover, for the same molding pressure, the obtention of molded products presenting a compactness and consequently an apparent density which are higher than that of agglomerated bodies manufactured by most well know processes. Inversely, for the obtention for molded products of a given density, it offers the possibility of using a molding pressure substantially lower than pressures generally used in the agglomerating processes known up to now.

The process according to the invention is essentially characterized by the fact that the pulverulent mass to be agglomerated and molded is mixed with a solution of sodium silicate and with a substance capable of decomposing the latter thereby giving rise to the formation of nascent silica having the power to ensure the setting of the mixture, in the presence of a dispersing-wetting agent, and in that the mixture thus obtained is then molded.

The dispersing-wetting agent utilized in accordance with the invention diminishes the surface tension of the liquid and allows the uniform distribution, in an extremely thin layer, of the sodium silicate around all the particles of the substance to be agglomerated. Accordingly, by operating in the presence of a dispersing-wetting agent, the proportion of sodium silicate to be used in order to obtain a good agglomeration may be considerably reduced with respect to that which would be necessary were the mixture effected without the presence of such a dispersing-wetting agent. In general when using a sodium silicate solution at 36° Bé., this proportion may vary from 2 to 8% by weight with respect to the pulverulent mass to be agglomerated.

The reaction of decomposition of the sodium silicate may be, notably, as it is known "per se", a catalytic reaction, in which case the substance which is added to the pulverulent mass to obtain this decomposition plays the unique or principal part of a catalyser. To that purpose, it is possible to use such substances as, for instance, fluosilicates, fluotitanates, fluotungstates, fluozirconates of sodium or of potassium. In certain cases, which will be specified hereafter, it is also possible, to attain the same object to use impalpable silica freshly ground. To allow the use of the smallest possible quantity of catalyser, it seems desirable that the ratio

$$\frac{SiO_2}{Na_2O}$$

of the sodium silicate be at least equal to 3,2. However, it is preferable that this ratio do not exceed the value of 3,35 so as not to hinder the reaction giving rise to the formation of nascent silica.

A real stoichiometric reaction may also be used by causing the flocculation of nascent silica by any reacting agent having a pH lower than that of the sodium silicate solution or containing or capable of liberating a molecule of free acid the acidity of which is at least equal to that of the silica. Along the same line of thought, it is possible to use, in order to obtain this reaction, bicarbonates or tricarbonates which, in the presence of water, give rise to free carbonic acid, or again, a sulphate, such as, for instance, aluminium sulphate which, in hydrolysing, produces sulphuric acid. It is also possible to use a sulphide capable of liberating, by hydrolysis, hydrogen sulphide which then acts as a weak acid, or an organic compound such as ortho or paratoluene sulphochloride which produces, by hydrolysis, one or several acids. Tests effected to this day seem to have revealed that, in the case

of a reaction of stoichiometric decomposition, the ratio

$$\frac{SiO_2}{Na_2O}$$

of the sodium silicate may be lowered to about 2,5.

Depending upon the case, the reaction of decomposition of the sodium silicate may be more or less rapid. It is advisable that it be sufficiently slow to allow the operator to effect the necessary handlings before the setting be complete, but sufficiently rapid that the agglomerating time is reduced to a duration that corresponds to industrial needs. According to necessities, a catalyser acting more or less rapidly will be chosen.

The binding, one to another, of the particles of the pulverulent substance to be agglomerated may, depending upon the case, result from the fixation of the nascent silica-formed by the decomposition of the sodium silicate—or to constituents elements of the substance to be agglomerated or contained in the latter or on to bodies introduced for this purpose into the substance to be agglomerated. Thus, for example, when the pulverulent substance to be agglomerated contains silicious bodies (free silica or silicate), it is probable that the freed nascent silica will combine superficially with these ingredients to form complex silicates which will ensure the desired agglomeration. If it is desired to agglomerate a metal in powder form or in the form of filings, it appears that the nascent silica resulting from the decomposition of the soda silicate forms with the metal or with the oxide of the surface layer a small quantity of silicate but sufficiently large to bind together the metallic particles.

If, on the contrary, the substance to be agglomerated does not contain bodies capable of constituting combination points for the freed nascent silica, it is possible to add to this substance bodies adapted to perform this function, for example, fine impalpable, freshly ground silica. In this case, the silica introduced in this state into the substance to be agglomerated appears to act the part, not only of combination points for the nascent silica, but also that of a decomposing catalyser for the sodium silicate. It is also possible—if it is desired to agglomerate a pulverulent fuel, for example, and although this measure may appear at first sight to be formally counter-indicated—to add to the latter a small quantity of cinders in order to cause the formation of combination points for the freed nascent silica.

By the process according to the invention, it is possible to agglomerate, generally speaking, substances not having a tendency to swell up, and particularly: ferrous metal filings (cast iron, steel, etc.) as well as non-ferrous ones (copper, bronze, zinc, aluminium, magnesium, etc.); inactive substances containing or mixed with free silica or a silicate; pulverulent ores or ores in the state of flottation powders or the like, with or without the additions necessary for their use in metallurgy, such as coal or reducing coke, substances for correcting slags in view of the elimination of impurities out of the finished metal, etc.; the dusts of blast furnaces or of furnaces for white metal, containing or not-containing coke dusts or other dusts; materials and products for refraction linings such as silica, silico-aluminous materials, zircon (zirconium silicate) etc. . . . ; graphite, treated or not, with or without the addition of other substances; mica in small pieces or in powder form; cold setting cements; fuels not having a tendency to swell, such as charcoal, certain coals and in general all carbonaceous materials distillated at a high or low temperature.

As wetting and dispersing agents for carrying out the invention, it is possible to use, for example, condensation and sulfonation products of aromatic hydrocarbons and of their derivatives with aldehydes, alcoyl—and aralcoyl—naphthalene sulphonates, sulphonated derivatives of fatty bodies, fatty alcohols, fatty acids, amides of fatty acids, amines derived from fatty acids, esters of fatty acids, sulphonation products of the residues resulting from the distillation of benzoic aldehyde, products soluble in water resulting from the action of ethylene oxide on substances insoluble in water and containing a reactive hydrogen, and other analogous products; substances of vegetal origin possessing dispersing and emulsioning properties such as licorice, saponin, products resulting from the hydrolysis of albuminoid substances, residual lyes resulting from the treatment of ligneous substances by means of sulfites.

The weight of the catalyser, if recourse be had to a catalytic reaction, and the weight of the wetting agent are (within certain limits) practically independent of the weight of sodium silicate employed. The more wetting agent and the more catalyser there are, within limits which are not excessive, the greater will be the density of the compressed substance obtained and the quicker will the setting take place. In general, a good agglomeration is obtained—in a period of time allowing manipulations, without having to hasten excessively—with 6% of catalyser and 2% of wetting agent calculated with respect to the weight of the sodium silicate at 36° Bé.

For carrying the invention into practice it is possible to mix the pulverulent substance to be agglomerated with the catalyser for setting, with the dispersing-wetting agent, and eventually with the substance destined to form the combination points for the nascent silica (if the substance to be agglomerated does not contain any by itself) and then add the sodium silicate.

By a molding or slubbing operation, or by other similar methods, the mixture thus obtained is shaped into molded objects according to the invention.

It will be advantageous to vibrate or pervibrate (slightly or much) the mixture before subjecting it to compression. Preferably vibrating machines having a vertical reaction will be used for this purpose.

If it is desired to obtain agglomerated bodies having a high density, it is advisable to so choose the granulometry of the pulverulent substances entering into the composition of the mixture to be agglomerated that the smallest particles be capable of filling to the greatest extent possible the empty spaces existing between the largest particles. It is to be noted that, thanks to the invention, the pressure necessary to the obtention of agglomerated bodies of high density is substantially reduced in comparison to that of heretofore known agglomerating processes. Thus it is that in many cases an ordinary hand-press such as the one used for making brickets of slag mixed with a hydraulic binder, is sufficient.

Certain examples of carrying out the invention will now be given by way of indication.

Example 1

To obtain brickets of coke dust, a coke dust is taken the granulometry of which lies between

extra fine and 2 m/m particles, and a weight of sodium silicate at 36° Bé. equal to about 4 or 5% of the weight of the mass of coke dust is then added under the conditions predescribed as well as 6% of sodium fluosilicate and 2% of the dispersing wetting agent commercially known under the name of "Diastersol NDS," with respect to the weight of the silicate. The mixture is then compressed into pellets by a pressure of 200 kgs/cm².

If the coke dust is wet, solid sodium silicate is used instead of a solution of this silicate for the water of the coke acts, in this case, as a dissolving agent. The silicate being little soluble in cold water, the difficulty is avoided by using a silicate which is richer in soda, but in this case, more catalyser is added, thus neutralyzing the excess soda which has facilitated the dissolving of the silicate.

Example 2

To agglomerate pig iron filings, these filings were mixed with 6% of sodium fluosilicate and 2% of sulphonated lauric alcohol, with respect to a weight of sodium silicate equal to 3% of the weight of the filings. Once a thorough mixture was effected, this mixture was stirred with the 3% of sodium silicate at 36° Bé., until a thorough mixture was obtained.

These filings were then compressed into small brickets by exerting a pressure of 500 kilos per square cm.

Example 3

Pulverized coal was agglomerated by mixing the coal dust with 8% of sodium silicate at 36° Bé. with a quantity of sodium fluosilicate and of butyl-naphtalene sulphonate of sodium the total of which was equal to 6% of the weight of the sodium silicate.

The agglomerating pressure was 300 kgs/cm².

Example 4

Pulverulent anthracite was also agglomerated by using from 7 to 8% of sodium silicate at 36° Bé. with respect to the weight of the anthracite and, in addition, 6% of calcium sulphide and 2% of the wetting agent commercially known as "Tibalene NAM" with respect to the weight of sodium silicate used. The same pressure as in the preceding example was used.

Example 5

The agglomerating of pulverulent flotation ores (of lead, zinc, iron and of other flotation ores) has been obtained with quantities of sodium silicate at 36° Bé. varying from 3 to 8% with respect to the weight of the ore, the proportions of catalyser and wetting agent employed being respectively 6% and 2% with respect to the weight of the sodium silicate. The compression pressures were of the same value as those of the preceding example.

In the case where the ore was very wet it was possible to effect the agglomerating with solid sodium silicate under the same conditions as those in Example 1) above concerning the agglomerating of coke dust.

Example 6

For agglomerating graphite, it has been proceeded, generaly speaking, in the same manner, but by providing a preliminary preparation of the graphite. By means of any one of the well known processes, the graphite was transformed into graphitic acid which was washed and dried, then heated to red hot (about 1000° C.) while being sheltered from air. The graphite swelled and assumed a volume about twenty-six times greater than before heating.

Once the swelling up was effected, the graphite was compressed into lozenges under a pressure of 50 to 100 kgs/cm² and the said lozenges were heated to about 500° C., which operation gave rise to a much less intensive swelling. The lozenges increased from one to three times in volume and were disintegrated to some extent but remained agglomerated nevertheless with a tendency to recover the foliated structure. Finally, by means of an easy crushing effect, the lozenges thus treated were ground and the powdered graphite thus obtained was mixed with 2 to 4% of sodium silicate at 36° Bé. after having also been thoroughly mixed with 6% of sodium fluosilicate and 2% of the product sold under the commercial name of "quicktan," with respect to the weight of the sodium silicate.

Agglomerated bodies were then obtained by pressures which have varied between 25 and 1000 kgs per cm², these agglomerated bodies already having a very satisfactory hardness for a corresponding pressure of 25 kgs. The hardness increased as the pressure became higher.

Agglomerated bodies of graphite of this kind heated to 1000° to 1200° C. have remained unchanged and appear to be appropriate for the fabrication of electrodes, retorts, muffles, crucibles and other objects of which graphite forms a part.

In all the cases where the catalyser utilized has been sodium fluosilicate, the setting was complete at a temperature of 15 to 20° C. after about six hours. In the case where the ambient temperature falls below 15° C. the setting may be hastened by bringing the molded products in a stove to a temperature under 60° C. until the inner temperature of the products attains about 40° C. Preliminary tests have permitted to determine the stoving time necessary in each particular case.

Example 7

The agglomerating of refractory substances has also been obtained in order to allow the substitution to dinas bricks (which contain a very high proportion of silica and a few percent of lime) of bricks containing practically only silica.

Quartz was taken and ground at the granulometry usually adopted for the fabrication of dinas bricks and was then agglomerated by means of sodium silicate, a catalyser and a wetting agent by using from 5 to 6% of sodium silicate at 36° Bé. with respect to the weight of the silica, and on the other hand, 6% of catalyser and 2% of a wetting agent with respect to the weight of the sodium silicate. The mixing of these ingredients was effected along the general lines specified hereabove.

The mixture obtained was molded into brick shapes under a pressure of 500 to 2000 kgs/cm² and said bricks were subjected to a slow baking at a temperature gradually increased to 1500° C. The reaction which occurred in the course of the operation gave rise to the formation of nascent silica which united the quartz grains one to another whereas the volatile products of the catalyser progressively distilled due to the high temperature and escaped. As a result, the bricks obtained contained only silica grains, in the form of tridymite or criptoballite, soldered one to another, so to speak.

Example 8

Instead of using a fluosilicate as catalyser, it is also possible, as has been specified hereabove, to use freshly ground fine silica which also plays the part of an element permitting the combination of the nascent silica produced by the decomposition of the sodium silicate.

In this line of facts agglomerated bodies of zircona have been produced by thoroughly mixing 100 parts by weight of chamot of zircona with 2,5 parts by weight of freshly ground silica passed through a sieve of 300 meshes and 0.1 part of Diastersol NDS; then by adding to this mixture 5 parts by weight of sodium silicate at 36° Bé. The mixture thus obtained was molded into bricks under a pressure of about 500 kgs per cm² and, in this case, the products were dried in free air for several days. Then the products were baked under the conditions usually adopted for the manufacture of refractory materials of this kind.

GEORGES PASSELECQ.
ALEXIS SÉMÉNOFF.

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ALIEN PROPERTY CUSTODIAN

DEVICES FOR STARTING GAS TURBINE MOTOR PLANTS

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Application filed January 26, 1942

The present invention refers to the starting of thermal gas turbine motors. Starting devices are already known in which a power supplement is supplied to these motors by means of an auxiliary motor driving directly, or by means of a clutch, or by gearing, one of the shafts of the motor to start. But in these devices it is generally necessary to have recourse to an important installed power supplement.

According to the present invention, the power supplement necessary for starting is supplied in the form of pneumatic energy by a fan operating in series or in parallel, or successively and automatically according to both of these coupling possibilities, with the compression stages of the thermal gas turbine motor. The fan can be driven directly by this auxiliary motor or by a small gas turbine receiving its power from a second fan, less powerful, driven by the auxiliary motor with amplification of this power by combustion in the midst of the air supplied, or again by an auxiliary thermal gas turbine motor set off in advance by any auxiliary motor whatever; thus, in these two latter methods of driving the starting fan a sort of relay of the power involved is obtained.

The description which follows, with reference to the appended drawing, given by way of non-limitative example, will allow a thorough understanding of how the invention may be embodied, those peculiarities which appear both in the drawing and in the description constituting of course a part of the invention.

Fig. 1 represents curves the object of which is to render the principle on which the invention is based intelligible.

Figs. 2 to 7 illustrate in a sketch-form various embodiments of a starting device according to the invention.

When the speed of a thermal gas turbine motor increases from zero, the power taken by the air compressor, and, possibly, by the driven unit when the latter cannot be thrown out of gear or unloaded, increases with the rotation speed according to a law such as the one represented by curve *a* of Figure 1. The power output of the turbine depends on the speed and on the temperature of the motive gases and for each speed of the motive unit there is, for the turbine, a corresponding temperature limit for the mechanical organ most exposed. The maximum power which the turbine can safely deliver is then represented with relation to the speed by a curve such as *b*.

For low speeds, the curve is always located below the curve *a* which it cuts at A which point corresponds to a rotation speed number. Beyond speed number, the set is capable of operating alone and of supplying useful power. From a speed equal to zero to one number, that is while the motor comes up to speed, it is necessary to supply it with a power supplement represented by curve *c* in relation to the rotation speed.

The devices which will be described with reference to Figures 2 to 7 allow this result to be obtained in a rational manner.

In all of these figures, nothing is taken for granted as concerns the control means for the compressor of the thermal motor at rated load. In particular, the present invention applies just as well to thermal gas turbine motors with one or more lines of shafting, whether the compressor be operated or not by a turbine distinct from the motive turbine properly speaking and whatever be the grouping of the turbines connected in series or in parallel.

On Fig. 2 can be seen at C an air compressor which sucks in atmospheric air through conduit *a* and drives it towards the auxiliary turbine *ta* which is used to drive this compressor C. During this course, between the compressor C and the turbine *ta*, the air is heated in the combustion chamber *Ch* by the combustion of a liquid fuel fed by the burner *b*; the gases having performed work in the turbine *ta* then pass into the motive turbine *tm* the object of which is to supply useful power and drive an electric generator for example. The invention refers to the device which is used to start the gas turbine motor composed of the auxiliary turbine *ta*, of the compressor C and of the motive turbine *tm*. This starting device comprises a fan V which may be driven while the motor is coming up to speed by an auxiliary motor *k* (electric motor for instance). The delivery piping of this fan is connected to the delivery piping of the compressor C between this compressor and the combustion chamber *ch*. The suction end of compressor C is provided with a draught check valve r_1 the object of which is to prevent any return flow of the compressor current.

During the starting period, this check valve automatically opens when the compressor, having reached a high enough speed, the latter supplies a difference of pressure equal to that of the starting fan. r_2 is a draught check valve the object of which is to prevent the passage of the compressor current through the starting fan conducts. This check valve automatically

closes when the compressor supplies a pressure greater than that of the starting fan.

Let W be the maximum power supplement to be supplied during the starting period of the thermal motor; let W_v be the power supplied to the fan having a yield ρ_v, the available power of the air driven by the fan is $\rho_v W_v$. In the combustion chamber of the thermal motor, the use in the temperature of the air multiplies the available power by an amplifying factor K. At the inlet end of the gas turbine of the motive set a power $K\rho_v W_v$ is consequently available and if the yield of the latter is ρ_t, the available supplementary power on the shaft of the turbine is $K\rho_t\rho_v W_v$, which must be at least equal to W. By this means and by burning only a small supplementary quantity of fuel the starting of the thermal motor can be ensured.

Moreover, and since the product $K\rho_t\rho_v$ is in general greater than unity, the power of the motor which drives the starting fan will be equal to

$$\frac{W}{K\rho_t\rho_v}$$

that is to say inferior to W. By an appropriate construction, the product of the yields $\rho_t\rho_v$ can, even during the low speed starting periods, be equal to 0.5; the factor K can be very substantially greater than 2 so that the factor $K\rho_t\rho_v$ can be substantially greater than unity.

According to the embodiment shown in fig. 3, the starting fan V is mounted in series with the compressor. A draught check valve is branched onto the connecting piping between the delivery end of the fan and the suction end of the compressor; it closes when the fan ensures an overpressure at the suction end of the compressor and opens when the fan is stopped or when it does not supply driving pressure.

At the beginning of the starting period, the compressor resists, to a certain extent, the passage of the air current driven by the fan, so that during this starting period this embodiment is not as good as the preceding one. When the speed of the compressor increases, the point representing the operation of the fan located on its supply-pressure curve moves towards the increasing-supply zone and so it happens that at the end of the starting period the driving pressure of the fan becomes nil. At that moment, the check valve r_3 automatically opens; the compressor directly sucks in free air and the motor controlling the starting fan can be stopped.

In the embodiment of fig. 2, at the beginning of the starting period, the discharge of the compressor is nil, then increases progresisvely so that it can be brought to operate momentarily in a pumping zone. The embodiment of fig. 2 is consequently, from this point of view, not as good as that of figure 3 in which the compressor reaches its point of normal operation within the low pressure zone.

The embodiment of fig. 4 offers the advantage of the two preceding embodiments without having any of their inconveniences. The starting fan is simultaneously connected above and below the compressor. At the beginning of the starting period, as a result of the resistance which the compressor offers, the discharge of the fan nearly entirely takes place through the pipe t by-passed with regards to the compressor and the conditions of fig. 2 then prevail.

The compressor accelerates and the fraction of the air discharged by the fan and passing through the compressor increases. From a certain time on, the pressure at the delivery end of the compressor is greater than that generated at the delivery end of the fan. The check valve r_4 then automatically closes, the discharge into conduit t becomes nil and operating conditions are those of fig. 3. A check valve r_5 is mounted on a branch pipe of the connecting piping between the delivery end of the fan and the suction end of the compressor. This check valve stays closed as long as the fan ensures an overpressure; and opens to allow the compressor to suck in free air directly, as soon as the motor controlling the starting fan can be stopped.

As the operating conditions of figure 2 occur only at the beginning of the starting period during which the compressor is functioning at a low speed only, pumping risks which depend to a large extent on the compressibility of the air and on the mechanical power involved are non-existent.

Fig. 5 concerns a way of putting into practice the embodiment of fig. 4 in the case where two compressors C_1 C_2 are operated in series. The way in which the gas turbines controlling these compressors are grouped is immaterial. At the beginning of the starting period, nearly all of the discharge of the fan passes through the by-pass conduit t, the passage of the air through the compressors at rest meeting with a substantial resistance. The high pressure compressor C_2 being the smaller, starts off first; in accelerating, its resistance diminishes and a moment is reached when, thanks to the pressure it generates, the check valve r_6 closes, thereby suppressing any air discharge through the by-pass conduit t_2. The speed of the low pressure compressor C_1 also increasing, a moment is reached when the check valve r_7 closes thereby suppressing any air discharge in the by-pass conduit t_1; the entire discharge of the starting fan then passes through both compressors. A check valve r_8 is mounted on a branch pipe of the connecting piping between the delivery end of the fan and the suction end of the compressor C_1. This valve remains closed as long as the fan ensures an overpressure and opens to allow the compressor C_1 to suck in free air directly as soon as the motor controlling the starting fan can be stopped.

The application of the same lay-out may be extended to a group of any number whatever of air compressors mounted in series.

According to another embodiment of the invention, the power to be installed for starting purposes is reduced by having recourse to the following system.

With reference to fig. 6, the starting fan V_1, operating in conjunction with the compressor or compressors (not shown) of the gas turbine motor, in any one of the ways which have just been described, for example as shown in fig. 4, is controlled by a small auxiliary gas turbine T. A fan V_2 supplies the necessary compressed air for this turbine which air passes into a combustion chamber R where a certain quantity of fuel is burnt by a burner b_1. This fan V_2 is driven by an auxiliary motor (electric, for instance). In the case of a motor, driving V_2, the power of which is P, the power obtained from the compressed air in the auxiliary cycle is 0.8 P if the yield of the fan V_2 is supposed to be 0.8. This power is multiplied in the combustion chamber R by a certain factor; if the value of this factor is estimated as being 2, the power available fed into the turbine T is 1.6 P and for an efficiency value of 0.8 for

this turbine, the power output of same for driving the starting fan V_1 is 1,3 P.

This increase in the power supplied initially by the auxiliary motor is obtained at the cost of a certain consumption in fuel; however it is of no importance since it occurs only during the starting period.

The device which has been described can, of course, be utilized in operating fans set according to one of the several starting embodiments of Figs. 2, 3, 4, 5. The turbine T can also be coupled directly, or by means of a clutch, or by means of a speed reducer to the shaft of the main motive set.

Finally, the device may be used as a relay and each step may be multiplied in series with the preceding one thus furnishing an amplification of the starting power available. For example, the fan V_1 would discharge into a second combustion chamber similar to R_1 the gases produced driving a second turbine similar to T, but more powerful, which would in turn drive a fan more powerful than V_1 and so on up to the last fan of sufficient power to be coupled to the compressor or compressors in one of the ways described in connection with Figs. 2 to 5.

This manner of putting the invention into practice can itself be embodied in a particular way whereby the starting of the set is obtained by a thermal auxiliary gas turbine motive unit which supplies the power necessary for the driving of the starting fan V of the main set.

On Fig. 7, C is the compressor of this auxiliary unit, T its turbine and R its combustion chamber. The starting of the auxiliary unit is itself obtained either by the well known method consisting in utilizing a motor furnishing a power supplement, or by one of the devices constituting the object of the present invention. (This last case is that of Fig. 7 in which is shown a fan V_2 operating in conjunction with the compressor C in the manner described Fig. 4).

If the power necessary for starting a thermal gas turbine motor of 10,000 HP is, for instance. 500 HP the auxiliary gas turbine unit for starting purposes will have a power of 500 HP and in order to start said unit, approximately 25 HP for the fan V_2 will suffice. This auxiliary thermal motor can, once the main set has been started, be utilized for example for driving the auxiliary apparatus of the main set.

Finally, if a power installation comprises, side by side, several thermal gas turbine motors, one and only one auxiliary set will suffice to ensure the starting, one after another, of each of the main thermal motors by means of an appropriate distributing piping.

It is obvious that changes could be brought to the embodiment just described without, by so doing, going beyond the scope of the present invention.

LOUIS ARMAND HERMITTE.

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DEVICES FOR STARTING GAS TURBINE MOTOR PLANTS

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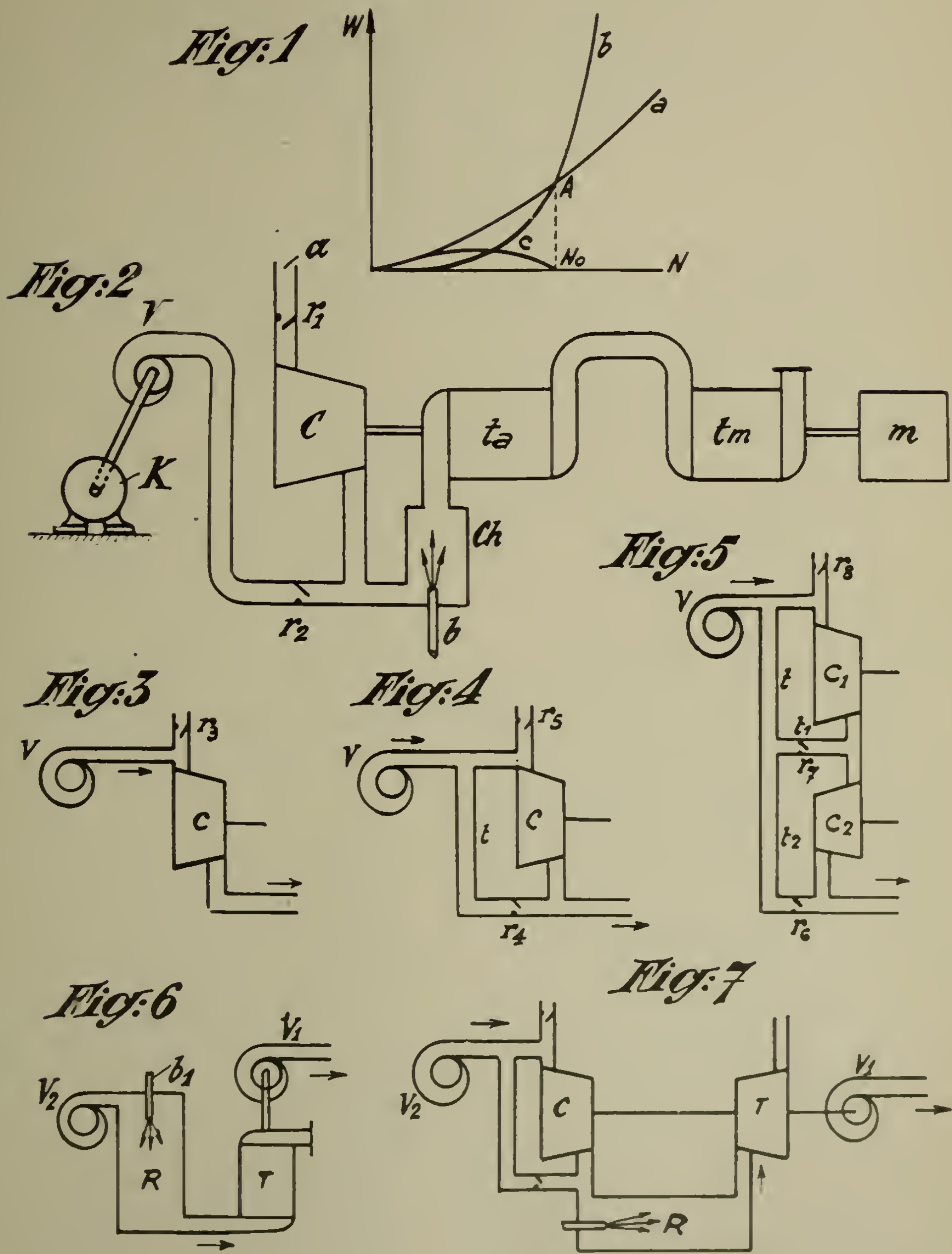

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CONDENSING SPENT STEAM

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Application filed January 29, 1942

This invention relates to the condensation of spent steam, and its purpose is to provide a condensing method which comprises the employment of cooling by air, possesses a high degree of safety of operation, and is economical, and also to provide the apparatus by means of which the new method can be successfully carried out in practice.

It is well known that the spent steam of condensing steam engines—the expression "condensing steam engines" comprising all such kinds of turbines and reciprocating piston engines, whose spent steam has to be condensed—has to be converted into water by condensation in the condenser and the heat liberated during this process has to be absorbed by means of cooling. Numerous kinds of known methods differing from each other according to whether they comprise the employment of condensers with surface cooling or of mixing condensers, and according to whether cooling is effected by means of water or by means of air, are being employed for this purpose; the operating and other properties of these methods vary widely.

The air-cooled condensers used up to now for condensing spent steam have been substantially surface condensers, in which the spent steam to be condensed was passed into the condensing chamber, the walls of this condensing chamber itself being cooled by means of air. It was in this chamber that the steam, transmitting its heat content to the condenser walls, condensed and it was from here that the condensate was removed by means of a water pump. In addition hereto the condenser was also connected to a vacuum pump, by means of which any air which had got into the condenser was removed. In addition to necessitating the employment of very costly exhaust steam mains, one of the main drawbacks of this condensing method was that in case any defect or leakage developed at any point of the air-cooled condenser, the surface of which was necessarily very large, air from the atmosphere was liable to penetrate immediately into the condensing chamber, in the interior of which a partial vacuum has to be maintained, and to impair this vacuum. The detection, during operation, of the place where the defect has developed, was, for reasons inherent to the design, practically impossible, and even with the plant shut-down such detection was a very complicated job, involving a great loss of time. A further drawback of the method referred to was that owing to the relatively high outlet velocities at which the steam left the steam turbine supplying the steam to be condensed and to the substantial length of exhaust steam piping required with this system, the outlet loss of the said steam turbine was liable to become increased in a substantial extent.

Another known condensing method is the one in which a mixing condenser is employed, the water injected into this condenser being re-cooled by means of water in a surface cooler. In the case of this method, the chemical composition of the water injected into the condenser is equal to that of the boiler feed water. The water leaving the condenser is divided into two portions, one of which is returned into the boiler as feed water, whereas the other portion is, after it has become cooled down during its flow through the surface cooler, which is cooled by means of unpurified water, again injected into the condenser. In the case of this method, accordingly, the water injected into the mixing condenser will, as it circulates in a closed circuit, not become soiled, and will therefore not require any special purification, whilst for making-up any possible losses it it easily possible to use the water introduced for making-up boiler water losses, by slightly increasing the quantity of such make-up water introduced into the system. It is an advantage of this method that any leakage of the mixing condenser, which possesses a relatively small surface, need hardly be feared; should, however, a defect develop on the water coolers, the surface of which is fairly large, this will result in unpurified cooling water getting into the boiler. This method of condensation, comprising cooling by water, can only be employed in those localities, where the necessary large quantities of cooling water are available, this circumstance excluding the possibility of its use in many cases.

I have found that by combining the two methods described above according to the invention, it is possible to obtain a method which, whilst avoiding the necessity of a supply of cooling-water, as required by the known methods employing cooling by water, at the same time possesses the economic and operating advantages of such methods, and furthermore, if carried out according to the preferred way disclosed hereinafter, possesses a substantially increased degree of safety of operation.

In the method according to the invention, the spent steam leaving the condensing steam engine, especially the steam turbine, is passed into a mixing condenser, into which air-cooled water, the chemical composition whereof is identical or substantially identical with that of the boiler feed water, is being injected. The mixture of injected

water and of water obtained by condensing the steam in the mixing condenser is drawn off from the condenser, and one portion of the said mixture is returned as boiler feed water into the boiler, whereas the remainder is passed through air-cooled surface cooler, preferably in such a manner as to cause the water to circulate in a completely closed circuit.

In a preferred way of carrying out the method according to the invention, the water pump supplying the water to be injected is adjusted so as to ensure that the pressure of the water circulating in the air-cooled water coolers should, even at the point of lowest pressure, exceed atmospheric pressure, e. g. by about 0.05 atmospheres or more. In this case the place of any defect developing on the air-cooled water coolers necessarily possessing a large cooling surface will immediately be indicated by the water escaping at that point, and, moreover, such defects cannot result in any air getting into the condenser and, accordingly, cannot cause any deterioration of the vacuum, but will only cause a certain amount of boiler feed water being lost. This loss, however, can, in view of the fact that it is very easy to ascertain the place at which the defect has occurred, be stopped very quickly, even without having to stop the operation of the plant for this purpose.

With the method described above, it is possible, according to the invention, to obtain a substantial saving of power, if, instead of throttling-down the injecting water pressure which is higher than atmospheric to the under-atmospheric pressure of the condenser, the reduction of the said water pressure is effected by passing the water through a hydraulic turbine installed into the injecting water main, and preferably located in closest proximity to the point where the water enters the mixing condenser, or even partially or wholly incorporated into said condenser. Such arrangement makes it possible to recover the amount of power required for driving the injecting water circulating pump, with the deduction of the losses, resulting from power losses in the pump and in the hydraulic turbine, as expressed in their respective efficiencies, and the pressure losses resulting from the resistance to throughflow of the piping and of the cooler.

Furthermore, it is very advantageous from the point of view of safety of operation, to effect the cooling of the water to be injected into the condenser by passing it through a plurality of air cooled water cooler units connected in parallel as this will enable any defect to be repaired also during operation, without any disturbance of service or reduction of output. Notably, if that unit on which the defect has developed is shut down in order to effect such repair, the cooling capacity thus temporarily lost can easily be recovered by putting stand-by units in commission, or, possibly, by temporarily increasing the cooling air velocities of the other units, particularly as, in any case, the whole system of cooling units has to be designed for the highest air temperature occurring during the year, which temperature therefore will probably not prevail on such occasions. A further important advantage from the point of view of undisturbed operation consists in the fact that only water of boiler feed quality circulates in the closed circuit, that is to say in the pipings, in the coolers, in the water turbine, and in the condenser, and therefore troublesome internal cleaning or removal of scale will not be required in these parts of the apparatus, and no unpurified water can get into the boiler in case of any defect.

It appears from all that has been said above that the method according to the invention will enable a very high degree of safety of operation to be obtained also in the case of condensation comprising cooling by air, whilst at the same time assuring moderate first cost, low working cost and a high steam turbine efficiency, whereas with such air-cooled condensers as were employed up to now it has not been possible to assure all these advantages simultaneously.

According to what has been said above, the apparatus according to the invention consists substantially of a mixing condenser connected to a condensing steam engine, and of an air-cooler connected into the injection water circulation of the said condenser, whilst at the same time a hydraulic turbine is preferably inserted into the water main through which the water leaves the coolers, and the air-cooled water cooler is preferably composed of a plurality of units connected in parallel. Substantial advantages of an apparatus of this type are that it requires little engine-room space, that its exhaust steam piping is inexpensive and that its condenser is relatively small-sized, added to which there are obtained, moreover, all the working advantages disclosed above.

The invention will be described further in detail with reference to the accompanying drawing, in which, by way of example, a certain form of apparatus according to the invention is illustrated diagrammatically.

It appears from this drawing, that the exhaust steam passes from the steam turbine **1** through the duct **2**, of small length and large cross-section, into the mixing condenser **3**, into which the cold water for condensing the said steam is introduced through the main **4**. The liquid mixture composed of the injected water and of the water of condensation leaves the condenser through the outlet **5**, and a part of this water of boiler feed quality is conveyed by the main **6** into the boiler feed pump **7**, whilst the remainder streams through the main **8** to the circulating pump **9**, arranged preferably in the immediate vicinity of the condenser. This pump feeds the water, increasing also its pressure above the atmospheric, into the cooling water main **10**. From this main the water, after passing through the parallel-connected air-cooled coolers **11**, **12** and **13**, possessing each a cooling surface of substantial magnitude, and being cooled-down in them, passes into the collecting main **14**, from which latter it returns again, through the hydraulic turbine **15**, into the condenser **3**, from which the air is removed by the air pump **16** connected to it by means of pipe **17**. The water fed into the boiler **18** is being converted into steam, and this steam feeds the turbine **1** through the main **10**. The coolers **11**, **12**, and **13** are provided with valves or cocks **110**, **111**, **120**, **121** and **130**, **131**, and are surrounded by the casing **20**, through which the cooling air is driven by the fan **21**. In actual practice it is, of course, preferable to employ, instead of the three cooling units shown on the drawing, a greater number of cooling units, of any suitable construction, which likewise are connected in parallel with each other between the mains **10** and **14**, and each of which is also provided with a cock or a valve at each end, for disconnecting it at will from the cooling circuit. Such cooling units also may possibly possess mutually different cooling capacities.

In the example shown on the drawing, the pumps 7, 9 and 16 and the fan 21 are shown as being driven by electric motors 70, 90, 160 and 210, connected to the mains 22 and 23 to which part of the electrical power is supplied by the generator 150 driven by the water turbine 15. The power obtained from this turbine, however, may be used to any suitable other purpose, and the drives of the pumps, fan and eventual other accessories also may be of any other suitable kind, and disposition.

Also, various other changes may be made in the details disclosed in the foregoing specification without departing from the invention or sacrificing the inherent advantages thereof. For example, the cooling device may comprise series-connected cooling units provided with by-pass mains and valves for enabling repairs during operation, such series-connected units constituting the cooling device by themselves or being interconected in parallel with other cooling units.

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BY A. P. C.

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CONDENSING SPENT STEAM

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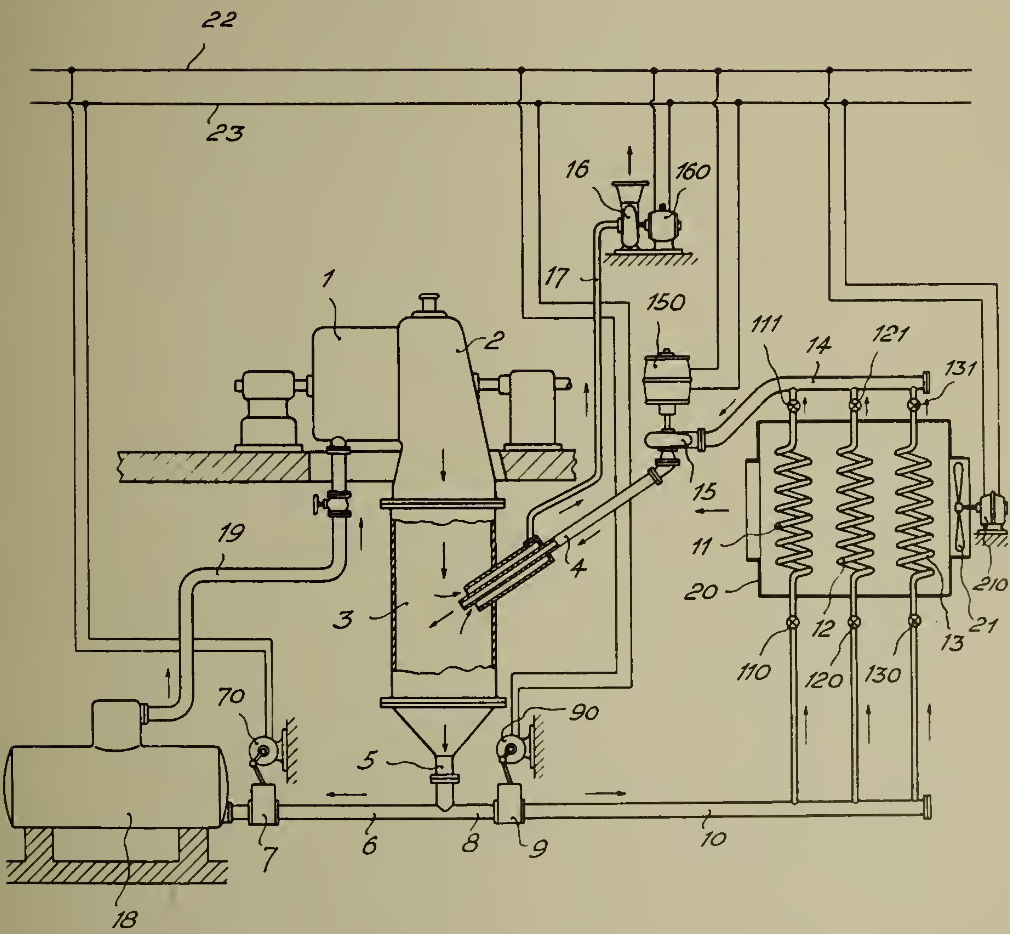

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ALIEN PROPERTY CUSTODIAN

PROCEDURE FOR STIFFENING ALL ELEMENTS COUPLED OF TIMBER-WORK IN LIGHT WOOD BY EMPLOYING OF THE TORSION OF WOOD ON CERTAIN OF THESE ELEMENTS

Jacques Couëlle, Marseilles, France; vested in the Alien Property Custodian

Application filed January 31, 1942

It is known to construct timber-works out of light wood, formed of planks carved as to the draught, giving a certain resistance to these planks in coupling same on the points and taking care, before doing so, to place the planks thus that their fibres be in opposite direction. The experience has shown that this particularity of mounting allows to use the mechanics phenomenons torsion, tension, relaxation of fibres, and chemicals (respiration of wood) which continues to work in its molecules, even long after having been cut, and which could be called life of the wood after its death.

Although experience has shown the qualities and advantages of this way of timber-work, these only can answer to small constructions, means those not surpassing average capacities.

However, the fact to use this work of the fibres of wood in a different manner can now allow to spread and generalize these timber-works light and economical in employing same even for very large capacities without weakening the resistance.

This is towards this realization being the object of this invention; and consisting of a procedure whose very purpose is the stiffening of all elements of the timber-work of light wood in employing the torsion of the fibres on certain of these elements. This torsion of fibres characterizes the invention.

The principle of this procedure and some of its application are shown on the annexed sketches.

Following these sketches:

Figures 1 and 2, essentially schematical, show the principle of the invention.

Figure 3 represents a well-known manner to give tension to the fibres of the piece of wood constituting a beam.

Figures 4 and 5 show respectively the principal element which assures by its torsion the stiffening of the fibres of all the other elements in wood which are coupled to them.

Figure 6 shows—seen in perspective—the application of the procedure on a flooring, following the invention.

Figure 7 seen in front and in elevation, represents the materials trimming and completing the flooring as shown in Fig. 6.

Figure 8 seen in perspective, shows application of the procedure on timber-work of large capacity.

Figure 9 shows, in a smaller scale, the possibility by comparison to extend this procedure of small constructions of weak capacity to those of sensibly larger.

In order well to understand the principle of tension of fibres in order to raise resistance of the ensemble, flooring or timber-work in wood, there is shown in Figs. 1 and 2 an example comparative the differences in degree of resistance of a fibrous body in neutral estate and in active estate.

Contemplating Fig. 1 there can be remarked that a string **1**, an essentially fibrous body, is hung up by its extremities **2** and **3** on the walls **4** and **5**. By its own weight this string will take a flexion as point A. If in this stand, there will be suspended to this string—whose fibres are in neutral estate—a weighty mass **6**, the fibres will tend under the influence of the weights and the flexion will accentuate into A*a*. If now Fig. 2 will be contemplated there can be remarked that the string **1** is sensibly tended by each of its extremities **2** and **3**; the fibres of string **1** are tended, they have changed out of the neutral estate of Fig. 1 into an active estate; if the same weighty mass **6** will now be suspended on this string which is tended it can be constated that the flexion as point A*a* is hardly sensible compared to that one showed on Fig. 1 and it can be concluded that the slight deformation of the string **1** is only due to the tension of its fibres.

In applying this principle there have been constructed since long time already beams of wood in two parties as shown on Fig. 3, and reposing one on the other by the surfaces **7** inclined (Jupiter-arrow) slipping with corner **8**, whose sinking between the two pieces is tending their fibres following the direction of the points and stiffening the ensemble of the beam thus raising its resistance against the flexion; but this enacting part is particular to beams of flooring and cannot be applied on timber-works, where the same effects of flexion, however, can be constated.

In the modern construction, especially in that one of hutting work, it is essentially employed those timber-work which constitutes the walls and the roofing at one time.

These timber-works, to be economical are executed in light green (young) wood, but this lightness and economy must not exclude the solidity; and the solidity exactly depends on the putting under tension of the fibres. In order to reach this result the principle, which is considered to be a new one, namely of the torsion of wood as per example shown on Figs. 4 and 5, is employed.

If a plank 9, Fig. 4, of some weak thickness will be considered in estate of rest, this plank, whose fibres are in a neutral estate, does not realize any reaction on itself; but as soon as it suffers a torsion-effort, as indicated in Fig. 5, immediately inverse reactions producing, whose directions are indicated by the points and arising of the changement of the fibres' estate which consequently are active and which will tend themselves in order to regain their neutral position. These reactions are the stronger the degree of the torsion will be more pronounced.

It is exclusively this principle which allows constitute timber-work floorings and any other applications, starting with employment of weak woods, whose fibres have passed to the active estate in order to arrive to ensembles extremely resistant.

This is like that, that it will be easy to construct a flooring, Fig. 6, in coupling planks 10 and 11 by the points or bolts in counterweighing them by the traverses 9, whose fibres' tension will be maintained by simple saw-traces 12, inclined and executed on the faces of the planks 10 and 11. This tension, which is produced by the traverses 9, will be transmitted to each of the planks 10 and 11 but in the inverse sense (as consequence of the opposed inclination of the saw-traces 12); thus is obtained a beam composed out of two parties working under tension by their fibres' active estate, as per the example shown in Fig. 2; and which is improving and raising their resistance towards the flexion in the vertical plan, as that already obtained by the arrow-Jupiter beam, shown in Fig. 3.

It still has to be considered that the fact to give a torsion to the entertoises 9, also is improving their resistance, they cannot more incurve, neither in one nor in the other direction, as could be done by an entertoise whose fibres stay in neutral estate, as shown in Fig. 4.

The timber of the flooring shown in Fig. 6, whose all elements are stiffened by torsion of the entertoises 9, is completed in this example, Fig. 7, by placing a frame-work 13, on which will be spread a slight beton (concrete) 14, which will cling on this frame-work by its penetrations 14*a* in it.

A coat, 15, will complete the superior party of this flooring ready to receive the parquet, bricks or other flooring, whereas the inferior party of this flooring will receive the elements 16, lathes or trellis of reeds, in order to receive the coat constituting, the vacuum B, created between the planks 15 and the ceiling 16 will allow, what can be called: respiration of the wood, indispensable for is conservation.

This same procedure of stiffening will be applicated with all its advantages in the modern timber-works, Figs. 8 and 9, and thus allowing to realize very high capacities, till now limited to rather small ones.

These elements of timber-work can receive, as the flooring shown on Fig. 7, a frame-work 13*a*, a slight mortar 17, and a tight coat 18. In the interior of the panels or surfaces 19 of cork, counter-plaked wood, agglomerates and of others completing the ensemble of these stiffened timber-works, will now be absolutely convenient for all particular or industrial constructions, such as halls, workrooms, stations, public establishments, churches and so on.

This timber-work out of light wood—the wood can be employed immediately after having been cut (green, young wood) can be applied to all usages, it can suffer some variations slightly different to those which have just been described herein; thus it is possible, that by its utilisation as flooring, Fig. 6 and 7, the vacuum B, can be furnished by application of a coffrage, a concrete of plasters and scria, slag or others, which by its porosity will allow the wood to respire. In this case the frame-work 13 is suppressed, and the flooring 15, as well as the ceiling 16, will be directly fixed on the field of the beams 10 and 11. This ensemble forming flags fortified by stiffened wood.

The same, the beams 10 and 11 are bound by panes 9*a*, Figs. 6 and 8, entertoising the wood-works and maintained by squares 9*b*; which allows to produce the principal elements standardized, absolutely interchangeable, and of small length; thus facilitating their transport, mounting or dismounting with the assistance of only one not-specialized workman. Their joining executed by held of bolts, passing in orifices perforated on the extremities of the planks 10 and 11. This ensemble is constituting "panel-work" of small length. Finally, the wall-plates and the ridges, 20 and 21 Fig. 9, are also of small length and could take two or three of the elements of the timber-work.

This disposition of timber-work in light wood can be used for the coffrage of tunnels, collectors, silos and so on.

This timber-work of light wood, stiffened in placing their fibres in an active estate, realizes a very big progress in the art of construction facultatively dismountable, easy and resistant, justified by the new industrial result, which surely is to obtain with light, green (young) wood, economical timber-work at standardized elements or not, and at a resistance which is superior to the actual one, thus allowing to reach very large capacities and to realize also—on the same conditions—flooring and other works such as coffrage out of light wood but very resistant ones, reducing the cubing which is sensibly diminished in relation to the asked efforts.

Recapitulation

Procedure to stiffen all elements coupled of timber-work in light wood by employing of the torsion of these elements only characterized by the torsion of the traverses or (entertoises) slight entertoises, joining two thicker planks to which they transmit their reactions; these planks suffer these reactions in the opposite sense and coupling themselves by fixation, points, screws or bolts, on other planks of the same mounting, in order to obtain an armed beam composed out of two planks leaning the one on the other and which fibres are in an active estate and of opposite reactions, thus raising their resistance against the flexion.

This procedure can constitute the standardized elements, constituted by:

1. Panel-work.
2. Panes, entertoising the panel-work.
3. Stiffening planks.

JACQUES COUËLLE.

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2 Sheets–Sheet 1

J. COUELLE

PROCEDURE FOR STIFFENING ALL ELEMENTS COUPLED OF TIMBER-WORK IN LIGHT WOOD BY EMPLOYING OF THE TORSION OF WOOD ON CERTAIN OF THESE ELEMENTS

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Fig.1.

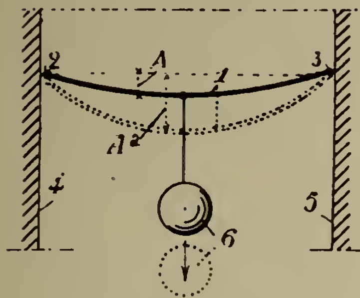
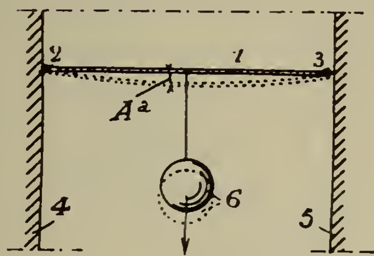


Fig.2.



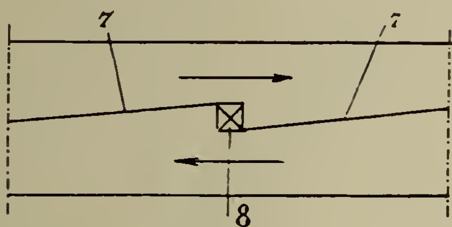
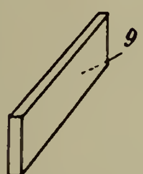


Fig.3.

Fig.4.



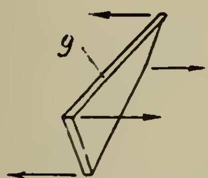


Fig.5.

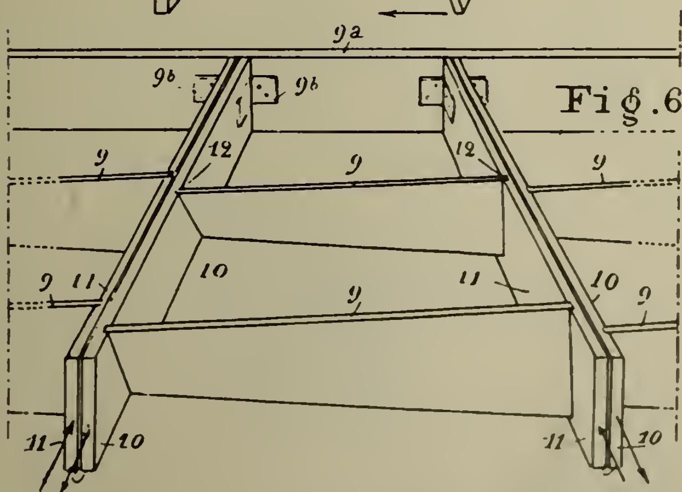


Fig.6.

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Fig.7.

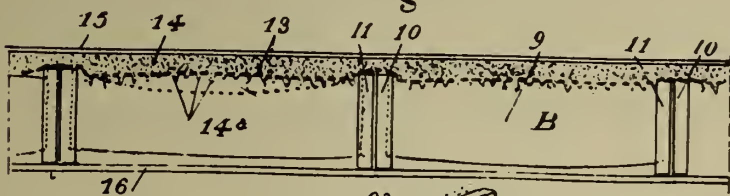
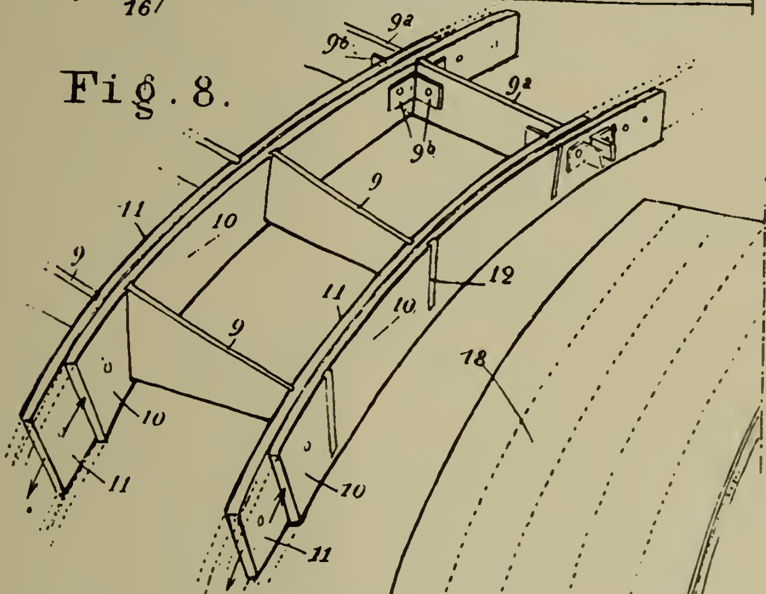


Fig.8.



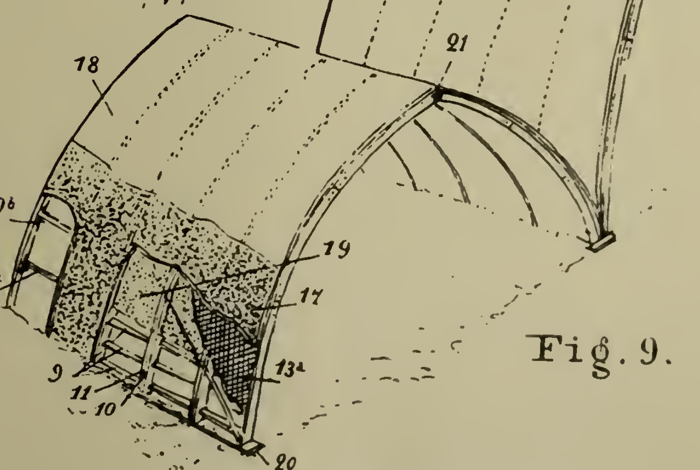


Fig.9.

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ALIEN PROPERTY CUSTODIAN

PRODUCTION OF FLAT GLASS

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Application filed February 13, 1942

This invention relates to the production of flat glass having a fire-polished surface, and has for its object to replace the methods hitherto in use for this purpose by a much simpler and cheaper method which, moreover, makes it possible to manufacture flat glass fire-polished on one side only. This is often desirable, particularly if the glass is to be used in making wall plates.

Flat glass having a fire-polished surface is at present obtained by drawing with or without nozzles, or by rolling on tables or machines in the manner of cast glass.

In order to produce or retain the fire-polish during drawing it is necessary to proceed in such manner that the glass while in plastic condition does not come into contact with solid bodies. Owing to the peculiarity of the drawing process, the glass thus produced is, however, always fire-polished on both sides, and its composition can be varied only within comparatively narrow limits.

The manufacture of flat glass by rolling requires a very high roller temperature and the greatest possible roller speed. Apart from the difficulties presented already by these requirements, it has further been found in practical operation that the surface of rolled glass of this type leaves much to be desired and at any rate does not exhibit the same degree of fire-polish as for instance drawn window glass. This is due to the fact that a sort of hammering is formed on the fire-polished surface during the rolling of the glass on casting tables owing to uneven cooling.

The machine rolling process involves similar troubles with respect to the condition of the surface, because the removal of the rolled glass confronts the operator with new difficulties in view of the high roller speeds and the still highly plastic state of the rolled ribbon, so that pulling stresses might develop. Furthermore, the high roller speeds, in order to render profitable the installation of a plant of this kind, presuppose production on such a large scale that the quantities delivered usually considerably exceed the absorptive capacity of the market.

The invention avoids these drawbacks of the known methods and affords, moreover, the possibility of selectively producing flat glass fire-polished on one or two sides and of adapting the output to actual requirements.

The principle of the invention resides in exerting a conveying effect upon the underside of a mass of glass emerging from a slot whose upper limitation is formed by a profiled body, whereby the glass accumulating in the rear of the slot is caused to be spun off from the inside of the mass and the outcoming glass is molded in the form of a ribbon.

According to the preferred form of application of the new method, this conveying effect is produced by employing as lower limitation of the slot a moving surface which drives the mass of glass by friction while on the other hand the upper layers of the glass stick to a certain extent to the profiled body which for this purpose is kept at a suitable temperature. The glass is thus formed by the moving surface representing for instance an endless band, a roll, etc. and possessing a smooth, roughened or profiled top to suit requirements, spun off as it were from the inside of the mass positioned back of the slot and delivered by the latter in the form of a ribbon which by the moving surface, or by a correspondingly inclined surface to which it is passed in the course of operations, is conveyed onwards and reduced to the desired thickness of the flat glass to be manufactured through regulation of the speed of the moving surface. Subsequently, the glass ribbon is either guided through the free space of the workroom to a cooling oven or treated in a heated chamber at correspondingly dropping temperatures.

In further accordance with the invention the slot from which the glass emerges may be formed by two adjustably spaced stationary profiled bodies instead of by a stationary profiled body and a moving surface, the conveying effect being exerted upon the moving support located rearwardly of the slot.

It will be seen that the surface of the glass having passed through the slot remains free from any contact between the moving surface and the profiled body and retains therefore its fire-polish even if the speed at which the liquid glass comes out of the slot is relatively slight.

Essential for the successful application of the method according to the invention are a suitably adjusted temperature of the liquid glass in the rear of the slot, the maintenance of a pressure exerted by the glass upon the slot that is as uniform as possible, i. e. keeping a practically constant glass level by the selection of corresponding charging methods and/or an appropriate construction of the container, an inclination chosen in view of these factors of the entire plant or of the conveying means in front of the slot, which may be as great as 45° from the horizontal according to manufacturing conditions, and finally and particularly the proper regulation of the con-

veying speed or of the speed of the moving surface.

Having reached a state at which the fire-polish cannot be disturbed any more, the finished glass may be treated of course in known manner with a polishing roller so as to smooth its surface still more if desired.

The invention is illustrated by way of example in the accompanying drawing showing a diagrammatic view of a device for performing the method according to the invention.

The mass of glass *b* emerging from a reservoir *a*, shown to be fed by a casting ladle, through a slot formed by a profiled body *d* of suitable refractory material and by a roll *c*, adjustably spaced from the body *d*, sticks to the latter and, owing to the friction of the surface of the roll *c*, is so to speak spun off from the mass and conveyed out of the slot. The ribbon formed subsequently passes to one or more conveying rolls *e* into a hearth type or roller cooling oven.

The change in the general arrangement involved when a stationary profiled body instead of the roll *c* serves as lower limitation of the slot and conveying rolls of the type of the rolls *e* perform also the work of spinning the glass off from the slot is obvious and for this reason need not be described.

The surface of the roll *c*, or of the rolls *e* employed instead of the former and assuming also the conveying task, or of an endless band, may be correspondingly profiled, which is important particularly if glass wall plates are to be made with a back insuring good adhesion to the wall.

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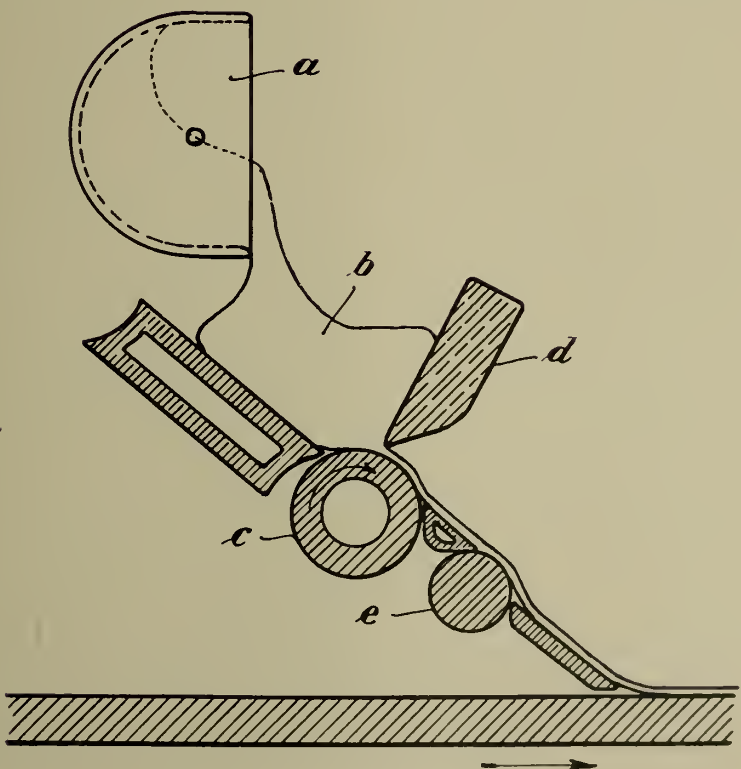

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Attorney

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ALIEN PROPERTY CUSTODIAN

CATALYSIS PROCESS WITH CONTINUOUS REGENERATION OF THE CATALYSER

Paul Woog, Paris, France; vested in the Alien Property Custodian

Application filed March 12, 1942

In many reactions which are effected in presence of a catalyser, the latter becomes modified during the operation. Outside the "intoxication" of the catalyser by foreign substances which become chemically fixed thereon, the ageing of the catalyser can take place by another mechanism; the covering of the active particles by products arising from the very reactions and which hinder the exchanges at the surface of the catalysing particles. The activity of the catalyser gradually decreases, the yields of the operation diminish and it becomes necessary to replace the spent catalyser, either by fresh catalyser, or by regenerated catalyser, that is to say by spent catalyser having recovered, owing to an appropriate treatment, a suitable activity. As type of a cycle of this kind can be cited the catalysis during which hydrocarbons in the vapour phase are treated at the required temperature on a catalyser, which is granular or in solid fragments, of alumina, porous silica, active clay, etc. In these conditions, the hydrocarbon molecules are decomposed and carbon or heavy bodies rich in carbon can be released; this inert residue of the kind of cracking thus effected, settles on the catalyser, surrounds it, reduces the closeness of the contact of the substances in reaction, slackens the exchanges and leads to a progressive diminution of the yield. The regeneration of such a spent catalyser can be easily effected by causing an air stream to pass over the catalyser heated to a sufficiently high temperature (of the order of 600°) so that the carburetted deposit becomes oxidized and gradually disappears by burning. The catalyser is then revived by said combustion which has freed its surface, and, brought to the temperature chosen for catalysis, it can be used again, become again spent, and be regenerated again, and so on.

It is generally deemed advantageous to use catalysers as active as possible; it is therefore necessary to replace the catalysers as soon as the diminution of their activity becomes evident. An important constraint and a very serious complication of the operations result therefrom, owing to the fact that one is led to use the catalyser only for a short time—sometimes only a few minutes—so as to use it only during the period of maximum activity. Sets of catalysing chambers must therefore be available which are put in service successively, while the spent chambers are subjected to regeneration.

The present invention is intended to do away with this arrangement by effecting in a single continuous operation the cycle of catalysis and regeneration of the catalyser; moreover, the operations can be adjusted in such a manner that the catalyser only remains in service for a period as short as desired before being regenerated, so that the catalyser is always ready for catalysis with its maximum efficiency. Furthermore, the duration of the regenerating period can be simultaneously lengthened so as to ensure said regeneration completely and in the best conditions.

The accompanying drawing diagrammatically illustrates a method for carrying out the present invention, the ends sectioned at I—I forming in reality the extension of each other.

The gases or vapours to be treated are admitted at **1** and first pass through a pressure regulator **2** the function of which will be indicated later on. The products then reach the catalysing zone which extends from **3** to **4**, then escape, once treated, into **5**. The catalysing chamber proper is formed of an inclined tube **6** enclosing an Archimedean screw **7** and can be brought to the required temperature by any suitable means such as the casing **8** heated by a current of steam or of oil, an electric winding, etc. The regenerated catalyser is taken up at **4** by the Archimedean screw, and gradually rises, whereas catalysis takes place on continuously renewed surfaces; the catalyser is finally poured at **9** into a hopper where it accumulates, awaiting regeneration.

The spent catalyser is then taken up at **9** by an Archimedean screw **10** which conveys it to the regenerating zone proper **11**. There, the catalyser advances under the action of the Archimedean screw **12** whilst it is treated and subjected to regenerating temperature by any suitable means such as the casing **13**. The regenerated catalyser falls at **14**, where an Archimedean screw **15** takes it up again and feeds it into the hopper **16**. A last Archimedean screw **17** then conveys the catalyser to **4** where, taken up again by the screw **7**, it begins its cycle over again.

During regeneration, the catalyser must be heated in an oxidizing atmosphere (gas containing oxygen, generally air). Said air is admitted at **18** and passes under the control of a pressure regulator **19**, passes through the regenerating zone **11** and escapes at **20**. Said pressure regulator **19** is rigid with the pressure regulator **2** with which its function is rigidly connected and the unit **2—19** operates closely in parallel, so that the products to be treated and the air for regeneration reach and pass through the apparatus in which the reactions take place with the

same pressure, losses of charge being taken into account; this equality of pressure must essentially be obtained in the two regions in which the catalysing zone and regenerating zone are contiguous. It is important, in fact, that the fluids should remain juxtaposed and not penetrate each other, either because of a difference of pressure, or by diffusion, so as to avoid any formation of an explosive mixture liable to cause accidents, by contact with a hot point where a deflagration might occur.

In addition to the condition of equality of pressure, obtained as just stated, the mixture or the diffusion of the fluids is also prevented, on the one hand, owing to the arrangement of hoppers in which the catalyser accumulates, the grains of the packed catalyser themselves forming an obstacle to the free circulation of the gases and, on the other hand, by providing two steam cushions at **21** and **22**. The steam admitted through **23** and issuing through **24** evolves through crowns or grids perforated with holes at a pressure slightly higher than that existing in the general enclosure of the apparatus and thus pushes back on either side, the traces of gas which might tend to become mixed.

Most often, the temperature at which regeneration must be effected is higher than catalysing temperature. The arrangement of an enclosure **25** is provided on the path followed by the catalyser, in which enclosure the latter cools from the temperature it had at the issue from regeneration down to that which it must have during catalysis. This excess of heat might, of course, be recovered and used to improve the thermal output of the plant.

It will be easily understood that the useful working period of the catalyser and the period of regeneration are adjustable by the dimensions of the Archimedean screws and by their speed of rotation.

It is to be understood that the invention is not in any way limited to the embodiment given simply as an indication and not in a limiting sense and that numerous modifications of detail and even of structure may be made without departing thereby from the scope of the present invention; it is thus for instance that, in some cases, the catalysing chamber can be horizontal, the regenerating chamber inclined, the steam cushions be separated or not from the gases to be treated by cushions of catalyser, etc.

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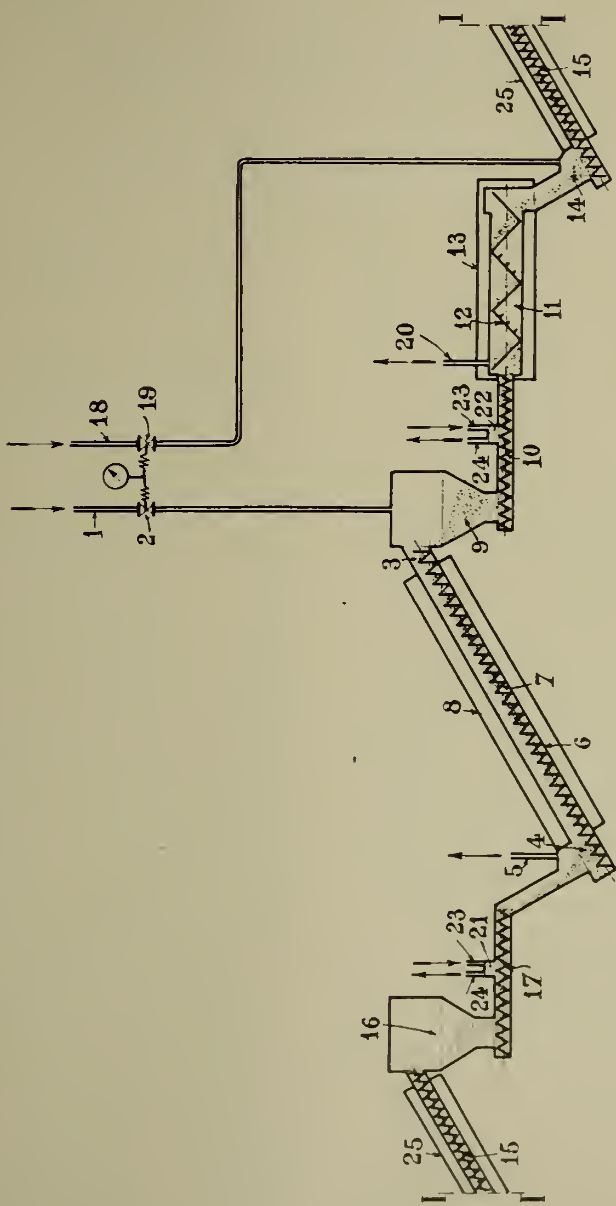

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ALIEN PROPERTY CUSTODIAN

PROCESS FOR THE CONVERSION OF WATER-INSOLUBLE POTASSIUM SALTS OF HIGH-POLYMERIC METAPHOSPHORIC ACIDS INTO A WATER-SOLUBLE STATE

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No Drawing. Application filed March 13, 1942

This invention relates to a process for the conversion of water-insoluble potassium salts of high-polymeric metaphosphoric acids into a water-soluble state.

The water-soluble alkali metal salts of polymeric metaphosphoric acids have been extensively applied in industry, for example in water-softening and washing, as cheese melting salts etc. The phosphoric salts of potassium, however, could, owing to their insolubility in water, up to now not be used for these purposes, in spite of the specific qualities of potassium. Therefore, it was a special necessity to treat water-insoluble potassium salts of high-polymeric metaphosphoric acids in a suitable manner, so as to make them water-soluble.

Potassium metaphosphate is known to become water-soluble by addition of sodium hexametaphosphate or sodium pyrophosphate. These anhydrous phosphates used as a solvent possess, however, an identical or homogeneous anion and have the further disadvantage of considerably reducing the effectiveness of the high-polymeric phosphate, as observed for example with the so-called phosphate-threshold-treatment.

Now the surprising discovery has been made that water-insolubility of potassium salts of high-polymeric metaphosphoric acids can be removed not only with the aid of anhydrous phosphates, viz. pyro- or hexametaphosphate, but also by addition of other sodium compounds, such as sodium hydroxide or sodium salts of anions different from that of anhydrous phosphoric acid. Moreover, other alkali metal salts, such as those of lithium and ammonium, have also proved suitable for this purpose. The effect obtained is quit surprising, since according to a general rule in chemistry the solubility of a chemical substance is greatest in an agent of homogeneous structure, so that the solubility of potassium metaphosphate in anhydrous phosphates could not simply be generalized and above all, since for example a saturated solution of sodium chloride is known to precipitate high-polymeric, water-soluble metaphosphates.

Among the alkali metal compounds suitable for the process of the present invention be enumerated the following ones: sodium hydroxide and the sodium, ammonium, and lithium salts of hydrochloric acid, carbonic acid, boric acid, silicic acid; further the salts of organic acids, such as fatty acids, benzoic acid, acetic acid, citric acid, as well as the alkali metal salts of a sulphonated product of fats, oils, fatty alcohols, and other organic compounds of high molecular weight which can be sulphonated. Sodium sulphate has proved to be especially opportune, because it delivers very viscous solutions and besides, owing to its low price, offers considerable economical advantages. The superiority of the sulphate iron over other anions, for example chloride, concerning their ability of dissolving potassium metaphosphate, is the more surprising as the former is generally a stronger precipitant for colloids than chlorides. The present process is favourably carried out by mixing solid potassium metaphosphate with a dilute aqueous solution of any sodium compound, whereat a certain concentration of the solvent should not be exceeded. This critical concentration varies for the different sodium compounds: it is for example for sodium hydroxide between 1 and 3 volume percent, for sodium chloride and sodium nitrate between 2,5 and 5 volume percent, for soda between 1 and 5 volume percent, for sodium acetate between 4 and 6 volume percent, and for sodium sulphate between 13 and 15 volume percent. The critical concentration is determined by adding to a high-polymeric, water-soluble phosphate varying concentrations of the sodium compound to be tested.

The potassium metaphosphate can be dissolved at ordinary temperature. Heating, however, accelerates and intensifies the dissolving process. Of course, the solid salts can also be mixed with each other before dissolution, and water then be added. The so obtained solutions can now be directly applied for the different purposes, for example as water softening agents, washing and cleaning agents, since they can be mixed in known manner with usual washing-active substances, thereby not only offering the particular advantake of linking the metal ions of the alkaline earths contained in the water into complex state, but—owing to their colloidal character—also increasing the capillary-activity of the washing agents. The special advantage of the claimed process consists among others in the fact that, in consequence of the multiplicity of possible combinations, mixtures of varying character, complying with all requirements, can be produced.

Example 1.—To 0,5 g of potassium metaphosphate are added 100 ccm of a 1% solution of sodium chloride. A clear solution with a specific viscosity of ηsp. 0,800 is obtained.

Example 2.—0,5 g of potassium metaphosphate are dissolved in 100 ccm of a 1% solution of sodium sulphate. The viscosity of this solution is ηsp. 1.975.

Example 3.—1 g of potassium metaphosphate

is dissolved in 100 ccm of a 2% solution of sodium sulphate. The resulting solution has a specific viscosity of $\eta sp.=3{,}04$.

Example 4.—1 g of potassium metaphosphate, dissolved in 100 ccm of a 10% solution of sodium sulphate, yields an aqueous solution with a specific viscosity of $\eta sp.=0{,}545$.

Example 5.—With 2,5 g of potassium metaphosphate in 100 ccm of a 5% solution of sodium sulphate a solution with a specific viscosity of $\eta sp.=0{,}379$ is obtained.

Example 6.—1 g of potassium metaphosphate is dissolved in 100 ccm of a 2% solution of sodium carbonate. The specific viscosity of this solution is $\eta sp.=0{,}819$.

Example 7.—1 g of potassium metaphosphate is dissolved under heating in 100 ccm of a 5% solution of ammonium chloride and then cooled. The solution has a specific viscosity of $\eta sp.=0{,}57$.

Example 8.—1 g of potassium metaphosphate is dissolved in 100 ccm of a 5% solution of lithium chloride with subsequent cooling. The specific viscosity of the resulting solution is $\eta sp.=0{,}758$.

For certain applications, especially for the cleaning of the hands, it is desirable that the products be of well mouldable constitution. Now, after a series of experiments, we succeeded in obtaining potassium metaphosphate-containing, water-soluble, pilier (in German: pilierbar) products, by mixing potassium metaphosphate with the sodium or ammonium salt of a sulphuric acid reaction product with oils and fats, such as: "Monopol" soap, the sodium salt of the acid sulphuric acid ester of: castor-oil, oleic acid, fatty alcohols, fatty sulphonic acids etc., in presence of sufficient water, so that the mass becomes kneadable and mouldable.

Example 9.—22,5 g of the sodium salt of an acid ester from sulphuric acid with fatty alcohol with about 35% of sodium sulphate and 22,5 g of water-insoluble potassium metaphosphate are thoroughly mixed in a kneader under addition of as much water as is required for obtaining a doughy mass. Thereto are necessary about 7,5 g of water. In order to accelerate homogenization, it is recommendable to treat the kneaded mass on a rolling machine (in German: Walzenstuhl) as used in the manufacture of soap shavings and then to work the shavings in usual manner.

Example 10.—16 g of technical cetyl sulphuric acid sodium and 6,5 g of potassium metaphosphate as well as 2,5 g of a 10% aqueous solution of the sodium salt of cellulose glycolic acid ester are thoroughly kneaded. 1 g of water is slowly added for reasons of a suitable constitution. As soon as the mass has reached the desired homogeneousness, it is worked as per example 9.

The moulded pieces according to the present process can be used in the same way as normal soaps of fatty acid alkali. Just as these, they may have added any filling materials, such as water glass, cellulose derivatives, starch, nonionogen washing agents, kaolin, etc. Moreover, the products can be adjusted either acid or neutral or alkalins according to requirement. They can also be combined with soap or soap-like materials, or additions of usual organic or inorganic colouring matter, perfumes, glycerine etc. can be made.

It is a particular advantage of the described products that, even at an extremely low fat content, i. e. 30%, they have the appearance and lathering power of normal soap and can be employed in any water, such as hard or salty waters, without any loss of fat or reduction of washing power.

It has further been found that well soluble, dry alkali metal double salts of high-polymeric metaphosphoric acids can be easily produced by dissolving, as described above, potassium metaphosphate in a dilute solution of alkali metal or ammonium salts, such as sodium chloride, sodium sulphate, NH_4Cl etc. with following precipitation by means of a suitable precipitant under mechanical mixing, for example stirring. In this way a fine-flocculent, non-caking alkali metal double salt, such as potassium-sodium hexametaphosphate or potassium-ammonium hexametaphosphate, easy to dry, is obtained.

As a precipitant are suitable: solutions of alkali metal salts, the salt content of which is higher than the point of critical concentration, for example 25% solutions of sodium sulphate, 10% solutions of sodium chloride, 10% solutions of NH_4SCN etc. Still better precipitants are the organic solvents which can be mixed with water, such as alcohols, ketones etc. The organic precipitants for the alkali metal double salts according to the present process can be applied in their anhydrous or hydrated form, or can be mixed with each other or diluted with aqueous salt solutions. Methylalcohol has proved particularly suitable, since yielding a very fine-flocculent, non-adhesive, and non-caking precipitate.

Example 11.—50 g. of water-insoluble potassium metaphosphate are brought into 175 ccm of a solution of sodium sulphate, containing 61,3 g of $(NH_4)_2SO_4 \cdot 10H_2O$, which mixture is left to itself until complete dissolution. Subsequently, the viscous liquid is diluted with water to a volume of 2 litres. Precipitation is accomplished by slowly stirring into 2 litres of 75% methyl alcohol. After some time the clear liquid is decanted, the deposit digested with 2 litres of 50% methanol and then filtrated. The potassium-sodium metaphosphate thus obtained is free from sodium sulphate and can be dried. In order to accelerate drying, the last traces of water are removed by treatment with pure methanol. Thereby, rapid drying is possible without heating. This product is easily soluble in water and its specific viscosity in a 0,5% solution is $\eta_{20°}=11{,}5$.

Example 12.—10 g of potassium metaphosphate are dissolved in 1 litre of a 1% solution of ammonium chloride under heating with subsequent rapid cooling. For precipitation the solution is stirred into 1 litre of methanol, the turbidity formed at the beginning changing into an easily dispersing precipitate of high-polymeric potassium-ammonium metaphosphate. Further working as per example 11.

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ALIEN PROPERTY CUSTODIAN

PROCESS FOR THE PREVENTION OF RESINOUS PRECIPITATIONS IN PAPER-MAKING

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No Drawing. Application filed March 13, 1942

This invention relates to a process for the prevention of resinous precipitations from the cellulose used in paper-making.

The greater part of cellulose serving as initial material in paper-making contains according to the employed raw material and the process of regeneration varying amounts of resin. Especially the cellulose obtained by the sulphite process or from fresh wood contains sometimes more than 1% of resin proving very disadvantageous in the following manufacturing process, particularly of fine paper sorts, since the resin precipitates as a sticky substance in the edge mill, crusher, called "Wurster", rag-engine and at the paper sieve of the engines, leading to various difficulties and interruptions in the manufacturing process.

It has already been endeavoured to eliminate these difficulties by adding to the cellulose adsorbing agents, such as kaolin, which should reduce the stickiness of the resinous substances. The presence of kaolin, however, is undesired in many paper sorts and the precipitation of resin itself cannot be prevented by such additions.

Acid-eliminating agents have also been proposed for the present purposes. By their addition the stickiness of the resinous substances is, however, still increased. For this reason endeavours have also been made to add to the paper pulp alkaline reacting or alkali-eliminating agents which by saponifying the resins balance the disadvantageous action of the latter ones, but on the other hand effect—because used in excess—undesired swelling of the cellulose. Besides, the free alkali must again be neutralized by increased addition of an acid or of aluminium sulphate, which leads to high precipitations of resin-acid or resin soap. Finally the foaming of the dissolving or emulsifying resinous compounds is a disagreeable phenomenon.

Now it has been found that the precipitations of resins and resinous substances, such as hemicelluloses, xylanes and the like, can be prevented by adding to the cellulose acqueous solutions of the salts of phosphoric acids in amounts of generally not more than 1% of the cellulose weight, whereby neither the usual manufacturing process is affected in any way, nor the paper fibre or the pH-value considerably influenced. For the effectiveness of the present process it is above all important not to exceed the maximum amount of about 1% in the case of alkaline reacting salts and about 2–3% in the case of acid salts, because upon additions beyond the mentioned percentages the emulsifying and saponifying action which is characteristic for the phosphates begins, eliminating the saponifiable substances, such as the resin, out of the substrate, thus making them removable by washing. In the present process such a phenomenon is, however, undesired, because it affects the swelling of the paper fibre as well as the pH-value and causes the foaming of the mass, whereas the disagreeable resin precipitations do not cease. Upon additions of less than 1%, especially 0,1 to 0,4%, of the dry weight of cellulose, resin and resinous substances are no longer precipitated from the fibre, but remain in homogeneous distribution on it.

Besides the salts of phosphoric acids, the water-soluble salts of aminocarboxylic acids, containing more than one carboxylic acid group per amino nitrogen atom, standing in α-position, thereto, and containing also an organic radical, but free from an alkyl or cycloalkyl radical having 10 or more carbon atoms when the whole molecule contains only 2 carboxylic acid groups, have proved effective in the process according to the present invention. As representatives of the simplest compounds which are obtainable by acting with ammonia on monochloracetic acid or by saponifying nitriles be mentioned the trimethylamine-α-, α′-, α″-tricarboxylic acid of the formula:

$$N\begin{cases}CH_2.COOH\\CH_2.COOH\\CH_2.COOH\end{cases}$$

the iminodiacetic acid of the formula:

$$NH\begin{cases}CH_2.COOH\\CH_2.COOH\end{cases}$$

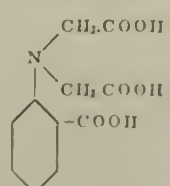
and such iminodiacetic acids, in which the hydrogen atom of the imino group is substituted by an alkyl, aryl, aralkyl or oxyalkyl group, such as the alkyliminodiacetic acid of the formula:

$$\text{Alkyl}-N\begin{cases}CH_2.COOH\\CH_2.COOH\end{cases}$$

or the aryliminodiacetic acid of the formula:

$$\text{Aryl}-N\begin{cases}CH_2.COOH\\CH_2.COOH\end{cases}$$

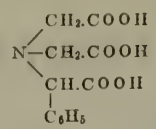
Further the anthranilic-N.N-diacetic acid of the formula:



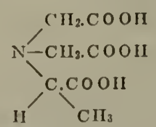
which contains in the aryl nucleus an acid group standing in ortho-position to the carbon atom to which the imino group is attached.

By replacing the hydrogen atoms of the methylene group of the above trimethylamine-α-, α′-,

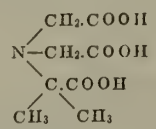
α''-tricarboxylic acid by alkyl or aryl groups suitable compounds are obtained, such as C-phenyl-trimethylamine-α-, α'-, α''-tricarboxylic acid of the formula:



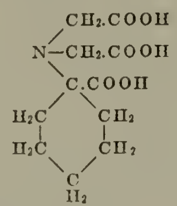
C-monomethyl-trimethylamine-α-, α'-, α''-tricarboxylic acid of the formula:



C-dimethyl-trimethylamine-α-, α'-, α''-tricarboxylic acid of the formula:



N-(1-carboxy-cyclohexyl)imino-diacetic acid of the formula:



The water-soluble salts of phosphoric acids can be applied in any degree of hydration. The preferred alkali metal and ammonium salts are those with a favourable pH-value, such as mixtures of mono- and disodium orthophosphate or of disodium orthophosphate and tetrasodium pyrophosphate. Mixtures containing sodium hexametaphosphate are also suitable for the present purposes. As especially effective have proved the water-soluble salts of polyphosphoric acids, above all of tripolyphosphoric acids, which have not only a favourable pH-value for the regeneration, but above all react advantageously in presence of hard water as well as upon the additions of aluminium salts and resin-sizing usual in paper-making. The phosphate additions can also be combined with acids, alkalis and adsorbing agents, such as kaolin, bentonite, water-glass and talc, which no not influence the intended effect.

Example 1.—250 kg of cellulose with more than 1% of resin are treated 1 hour in the edge mill with 1 kg of sodium tripolyphosphate dissolved in 10 litres of water and with about double the quantity of water from the dry weight of cellulose and then worked in the usual manner in the rag-engine, mixing through and paper engine which all remain free from resin. Old resin deposits on walls, stones and knives are gradually dissolved and can be removed without difficulty from the sieve. Engine parts with hard resin deposits are brushed before with a hot solution of 10 g per litre of sodium tripolyphosphate $Na_5P_3O_{10}$.

Example 2.—The cellulose passed through the edge mill or the crusher is prepared on the rag-engine with water in the proportion of 1:20. 1 kg of sodium tripolyphosphate $Na_5P_3O_{10}$, dissolved in 10 litres of water, is slowly added.

The phosphate additions can be made in the rag-engine or in any of the following manufacturing states, the effect obtained being the same as upon addition in the edge mill.

Example 3.—250 kg of cellulose are prepared with 0,5 kg of sodium tripolyphosphate $Na_5P_3O_{10}$, 2,5 kg of talc and double the quantity of water from the dry weight of the cellulose and passed through the edge mill as usual.

Example 4.—To 100 kg of cellulose with about 1,2% of resin, prepared with about double the quantity of water, are added 0,4 kg of the sodium salt of trimethylamino-α-, α'-, α''-tricarboxylic acid. After a treatment of about 1 hour the mass is drawn off and then worked in the usual manner in the edge mill, rag-engine, mixing through and paper engine.

ANTON VOLZ.

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ALIEN PROPERTY CUSTODIAN

PROCESS FOR THE PRODUCTION OF NITROGEN-PHOSPHORIC ACID COMPOUNDS

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No Drawing. Application filed March 13, 1942

This invention relates to a process for the production of nitrogen-phosphoric acid compounds having water-softening qualities.

It has already been endeavoured heretofore to produce similar compounds by starting from gaseous ammonia and solid phosphorus pentoxide. Apart from the fact that this process offers technical difficulties in its application, it has the disadvantage that the reaction occurring in connection therewith takes place partly non-uniformly and partly incompletely, resulting in producing various products of varying composition and very slight yield. Besides, the products thus obtained further contain impurities consisting of by-products and unaltered initial material, smelling in aqueous solution strongly of phosphoretted hydrogen.

Now the surprising discovery has been made that homogeneous nitrogen-phosphoric acid compounds of high yield are obtained by reacting urea with such phosphoric acids which have a lower proportion of water molecules than orthophosphoric acid, under heating, and adding to the resulting compound hydrogen peroxide, whereupon an extremely stable, solid product is obtained. These products are of special importance, since they have, in addition to their water-softening and washing-activating properties, the ability of ceding their oxygen in aqueous liquors but gradually and bleaching the treated goods. The possibility of producing the compounds according to the present invention is in so far particularly surprising as the reaction products from phosphoric acids and nitrogen compounds are—contrary to phosphoric salts which, too, are forming per-compounds—amorphous, non-crystallized compounds.

Example 1.—105 g. of a reaction product, obtained by thoroughly mixing 86 g. of an anhydrous phosphoric acid, the P_2O_5-content of which amounts to 82.5 to 83%, with 60 g. of urea under slowly heating to 150° C., are intensively stirred with 60 cm. of 33% hydrogen peroxide and then dried at a temperature of about 40° C., eventually at the application of vacuum. In this way a white, easy-pulverizable mass, containing 6.5 to 7% of active oxygen, is obtained. This compound having a P_2O_5-content of 44 to 45%, if employed in the amount of 15 g. per 100 litres and 1 degree of German hardness, is able to link the metal ions of the alkaline earths in the water into complex state and to bleach textile fibres. By variation of the proportions and working conditions, products with a different content of active oxygen or P_2O_5 respectively can be manufactured.

Example 2.—Equal weight parts of a reaction product, obtained by intensively stirring 86 g. of an anhydrous phosphoric acid, the P_2O_5-content of which amounts to 82.5 to 83%, with 60 g. of urea under slowly heating to 150° C., and sodium percarbonate are mixed and stirred with little water. The resulting compound is dried at about 30 to 40° C., eventually at the application of vacuum. A white powder with 5% of active oxygen is obtained.

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ALIEN PROPERTY CUSTODIAN

DEVICE FOR SUPPLYING A GASEOUS MIXTURE TO AN INTERNAL COMBUSTION ENGINE

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Application filed March 14, 1942

The present invention relates to the feeding of internal combustion engines by means of gaseous fuels and has for its primary object to provide a device of improved and simplified construction for feeding this type of engines with a constant composition mixture of combustible gas such as lighting gas or producer gas (hereafter called "gas") and of combustion-promoting gaseous fluid such as atmospheric air (hereafter called "air") so as to keep the kinetic efficiency of the engine as steady as possible.

Another object of the invention is to provide a gaseous mixture feeder wherein the inflow of the two constituents of the mixture is so automatically adjusted that the richness of said mixture remains substantially constant and the volume of gaseous mixture fed to the engine copes at all times with its rate of operation and consumption.

Still another object of the invention is to provide for feeding a gaseous fuel mixture to an internal combustion engine a device comprising mixture-intermingling means associated with self-regulating means whereby any pressure decrease in the gaseous fuel inflow, for example due to clogging of the scrubber interposed between the gas producer and the device, is automatically compensated so as to maintain the ratio of the mixture constituents substantially constant.

A further object of the invention is to provide a gaseous fuel mixture feeder for an internal combustion engine, the operation of which is so automatically adjustable as to ensure constancy of mixture regardless of the position of the throttle valve controlling the outflow of said mixture to the engine induction manifold.

With these and such other objects in view as will incidentally appear hereafter, the invention comprises the novel construction and combination of parts that will now be described in detail with reference to the accompanying drawing which exemplify several embodiments of the invention and form a part of the present disclosure.

In the drawing:

Figure 1 is a diagrammatic illustration of the simplest constructional form of device according to the invention.

Figure 2 is a similar view of a somewhat more elaborate constructional form of the device.

Figure 3 is a similar view of another constructional form comprising a flexible element made up of a pair of spaced membranes.

Figure 4 is a diagrammatic view drawn on a smaller scale of a constructional form similar to the one shown in Fig. 1 but comprising no mixing chamber for the gas and air.

Like reference characters designate like parts throughout the several views.

As illustrated in Figs. 1 to 3 inclusive, the device may comprise a pair of nozzles 10, 11 having Venturi outlines and projecting in converging relation through the oppositely slanting top sides of a mixing chamber 12 connected to an outlet pipe 13 fitted with a throttle valve 14 of conventional structure and operation and connected in turn with the engine induction manifold (not shown).

The nozzle 10 is provided at the end of a primary inlet pipe 15 through which a gaseous fuel such for example as lighting gas or producer gas may be admitted as shown by the arrow a^1. A secondary inlet pipe 16 serves for the intake of the air which flows as shown by the arrow a^2. The pipe 16 extends downwardly into a tightly closed casing or enclosure 17 and is elbowed at its lower end as shown at 18. The lower mouth 18 of the air intake pipe 16 is controlled by a disk-shaped valve 19 which is urged by a compression spring 20 into closing position. The spring 20 is coiled under suitable compression between the valve 19 and the adjacent end face of an adjuster screw 21 engaged in a tapped nipple 22 on the casing 17 and having an extension 23 by which it can be conveniently operated manually for varying the pressure exerted by the spring on the valve.

In the constructional form shown in Fig. 1, the inside of the casing 17 is divided into a pair of compartments sealed from each other by a resilient depressible membrane 24 having its peripheral edge tightly clamped between contiguous flanges 25, 26 formed on the outer wall of the casing 17. The central region of the membrane 24 which may be suitably reinforced or fitted with a small stiff member to that effect has a rigid connection 27 in the form of a push rod with the disk valve 19. The left hand side or secondary compartment 28 defined by the membrane 24 and the inner wall of the casing 17 is connected with the nozzle 11 by means of a tube 29. The right hand side or primary compartment 30 also defined by the membrane 24 and the inner wall of the casing 17 communicates by means of a pressure-tapping tube 31 of small sectional area with the gas intake or primary pipe 15.

Briefly described, the operation of the device shown in Fig. 1 is as follows: At rest, the membrane 24 and the disk valve 19 occupy the posi-

tions shown in dotted lines. Therefore, the air cannot flow into the mixing chamber 12. However, when the engine (not shown) is started, there occurs a depression which propagates itself through the induction manifold and up through the mixing chamber 12. This depression draws the gas through the intake pipe 15 and by creating a partial vacuum in the secondary compartment 28 of the enclosure 17 unseats the valve 19 against the antagonistic resistance exerted by the spring 20, so that the air can flow along the path shown by the arrows a^2, a^3 and a^4 into the chamber 12 wherein it becomes mixed with the gas fed into it through the nozzle 10. From the mixing chamber 12, and assuming of course the throttle valve 14 to be open, the gaseous mixture flows as shown by the arrow a^5 through the induction pipe 13 towards the engine (not shown). As will be understood, the casing 17 divided by the flexible membrane 24 into a pair of compartments 28, 30 respectively connected to the air and gas sources of supply functions as a pressure regulator or equalizer since the membrane assumes a position of hydrostatic equilibrium governed by the gas pressure in the compartment 30 and the depression which prevails in the compartment 28. Thus the flow of air into the compartment 28 is suitably controlled or throttled by the valve 19 to match the gas pressure prevailing at any moment and propagating itself through the small tube 31. Assuming the nozzles 10, 11 to have, so far as the flow of the two fluids is concerned, the same characteristics (which may be readily reckoned in a mathematical way in accordance with known laws of thermodynamics) it will be seen that insofar as the equality of pressure is preserved at the inlet of the nozzles 10, 11, the ratio of the quantities of gas and air which enter the mixing chamber 12 is maintained constant regardless of their original rates of feed through the pipes 15 and 16. By varying the degree of compression of the spring 20 by means of the adjuster screw 21, the flexible distortion of the membrane 24 may be more or less checked to suit prevailing conditions. Such an adjustment being performed when required so as to throttle the air flow, the new position of hydrostatic equilibrium of the membrane will bring about a reduction of the air pressure in the compartment 28 with respect to the gas pressure in the compartment 30. This will lessen the rate of air flow through the nozzle 11 and will consequently cause an enrichment of the gaseous mixture while still automatically maintaining constant the ratio of its gas and air constituents irrespective of the feed rates in the intake pipes 15 and 16. Such action will make it possible to compensate for any loss which may happen in the calorific value of the gas, due for example to fluctuations in the operation of the gas producer or to similar causes. A reverse adjustment may be readily effected if and when on the contrary the gas grows richer.

The constructional modification shown in Fig. 2 comprises in the tube 31 of small sectional area which interconnects the primary pipe 15 and the primary compartment 30 of the pressure-regulating chamber 17 additional throttling means which may be constituted for example by a perforated or foraminous diaphragm 32. The purpose of these throttling means is to prevent the membrane 24 from oscillating or vibrating due to the repercussions caused by the reciprocatory motion of the pistons in the cylinders of the engine (not shown). This constructional modification further comprises a partition 33 firmly secured to the inner wall of the casing 17 and formed with a central hole 34 through which the push rod 27 is freely guided and with a port 35 which provides the necessary communication between the left hand side portion of the compartment 28 and its right hand side portion adjacent the flexible membrane 24.

In the other constructional modification shown in Fig. 3, there is provided a second flexible mmebrane 36 also secured to the push rod 27 so as to move in unison with the first membrane 24. The peripheral edge of this second membrane 36 is tightly clamped between a pair of flanges 37, 38 formed on the wall of the casing 17. One or more holes such as 39 are provided in the casing 17 to establish a free communication between the space 40 defined between the membranes 24 and 36 and the atmospheric air. The purpose of this arrangement is principally to preclude the formation of a detonating gaseous mixture inside the pressure regulator if somehow the gas in the compartment 30 percolates through the membrane 24. Such a risk is particularly to be feared where such gases as acetylene or hydrogen are used. In the modified arrangement shown in Fig. 3, should the membrane 24 leak and the gas penetrate into the inter-membrane space 40, it readily escapes through the outlet hole or holes 39 and any cause of accident is thus inhibited.

The constructional modification shown in Fig. 4 comprises no mixing chamber such as the one shown at 12 in Figs. 1 to 3 inclusive. In this modification, the intermingling of the two constituents of the gaseous mixture takes place in the various cylinders of the engine. Such cylinders are not shown in the drawings as they may be of any conventional form, as will be understood by anyone skilled in the art. In this construction, the intake pipe 15 extends to form a distribution manifold 15*a* which is divided into a number of branch pipes 15*b* equal to the number of the engine cylinders. Each branch pipe advantageously has the Venturi outline as shown. The flow of the gas through each branch pipe 15*b* is controlled by a suitable valve such as a poppet valve 41 suitably operated with proper timing by any cam mechanism by means common in the manufacture of internal combustion engines. The pipe 29 similarly extends to form a distribution manifold 29*a* which is provided with a number of branch pipes 29*b* equal to the number of the engine cylinders. Each branch pipe 29*b* advantageously has the Venturi outline shown. The flow of air through each branch pipe 29*b* is controlled by a suitable valve such as a poppet valve 42 suitably operated with proper timing by a cam mechanism as above stated. The actuations of the valves 41 and 42 are of course so suitably timed and co-related as to permit proper intermingling of the two constituents of the gaseous mixture fed to the engine cylinders. It will be seen that in this arrangement the detonating mixture forms itself inside each engine cylinder, whereby any danger of explosion outside the cylinder is prevented.

Throughout the foregoing description, it has been assumed that the primary intake pipe 15 is connected to the gas supply while the secondary intake pipe 16 is connected to the air supply. This, however, is not limitative and the reverse might be the case, the air being then drawn in through the intake pipe 15, while the gas would be drawn in through the intake pipe 16. The

claims are correspondingly worded to include this alternative arrangement.

It will be seen that the aforesaid arrangement of parts permits the objects of the invention to be fulfilled inasmuch as, once the composition of the gaseous mixture has been manually adjusted to suit requirements, it is automatically maintained constant regardless of the operational speed and efficiency of the engine, of the position occupied at any moment by the throttle valve 14, and also of any loss of pressure which may happen in the gas feeding pipe up the pressure regulating device. This is due to the fact that in contradistinction to what exists in known feed devices the quantity of intake air admitted to the engine is not governed by the position of the throttle valve.

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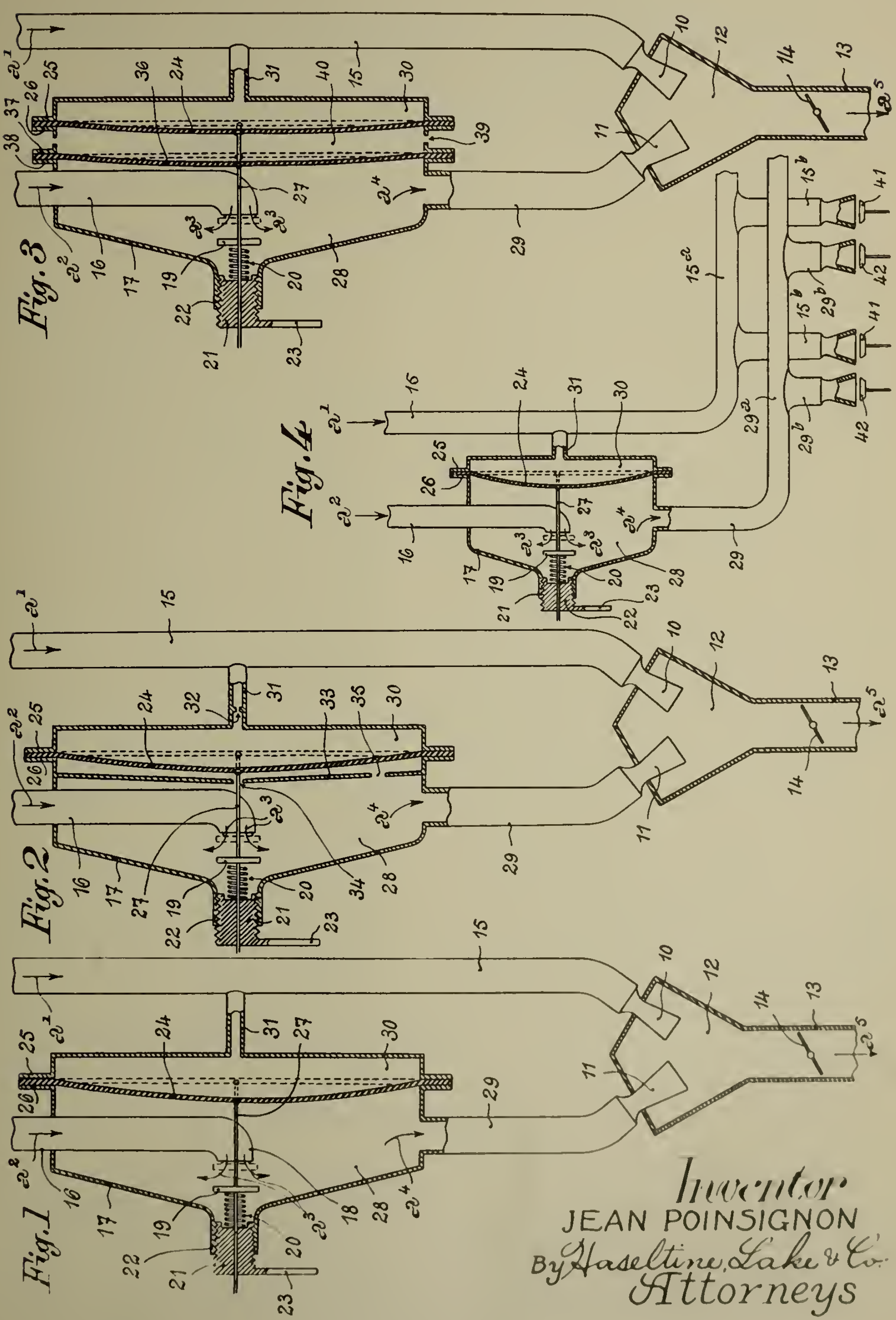

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ALIEN PROPERTY CUSTODIAN

ECONOMICAL OBTENTION OF HYDROGEN AND OF OXYGEN BY DISSOCIATION OF WATER IN ORDER TO REALIZE INDUSTRIALLY A GASEOUS FUEL EXTREMELY RICH IN CALORIES

Jacques Couëlle and Dimitri Costin, Marseilles, France; vested in the Alien Property Custodian

Application filed March 26, 1942

Fire necessary for industrial and home heating is one of the most important elements of life.

Until now coal or its underproducts have assured the maintenance of heat.

But as consequence of economic circumstances, resulting of political events the possibility of shortness in coal as fuel must be taken into consideration and it must be looked for simple and practical means in order to replace coal.

A great number of solutions have certainly been proposed which try to replace coal by gaseous or liquid fuel, but under actual circumstances even the possibility of coal missing for transports or fabrication must be considered, as well as efficiency in calories and way of utilisation.

Taking all these possibilities into consideration the object of the present invention consists in taking up again the dissociation of water under an essentially new and industrial form—in order to obtain very economically hydrogen and oxygen and to obtain by the mixture of these two gases extracted from water (element which can be found everywhere) a gaseous fuel of first value suitable for all industries where heating is necessary, for the powerful steam boiler as well as for the modest kitchen-stove.

It is essentially the practical realization of the well known principle of the dissociation of water, but obtained in a simpler way by means of a new principle which characterizes this invention.

This new principle and its means of realization are represented in a schematic way in the annexed drawing, which can be used as well as explanation for the working of the new apparatus and as basis of the practical execution of the apparatus of production.

In preference this apparatus is composed by a cylindrical body I in its lower part is disposed a furnace **2** and a tewel **3** of air admission.

Concentrically and in the interior of body is disposed a pipe **4** which forms the first catalysator, forming an elbow in its lower part and in which enters water pressure. The upper part of pipe **4** emerges in the interior of a second cylindrical body forming the second catalysator too and through which passes a part of the carbonic gas produced by furnace **2**. The upper part and forming elbow of body **5** gathers and leads the gases hydrogen and oxygen ready for use. The gases of combustion escape through a drain **6** formed by the upper part of body I.

These being the principal parts of the apparatus based on an essential new principle it is working in the following way:

As soon as furnace **2** which uses only a minimum of fuel is in action, pipe **4** is very much heated and now the water under pressure is sent into this pipe—under the action of its high temperature of about 1200° the water under pressure (about 50 grammes) is injected into the pipe **4** of pulverization: under the action of the high temperature the water is dissociated and the hydrogen and the oxygen can be found in pipe **4**, but as soon as they leave this pipe **4** they come into contact with a part of the carbon arising from furnace **2**.

This admission of carbon characterizes the invention because it determines in zone A the fixation of oxygen and as oxygen is heavier than hydrogen these two gases separate. It is this separation which characterizes essentially the present invention because their separation makes it possible to gather them separately, to mix them again and by combining them a very hot gaseous fuel is obtained which will be used with a maximum of efficiency, practically above 50% and which can arrive to 80 or 90%, according to the way of utilisation and according to the quality of fuel used for the heating of pipe **4**.

Experience has already proved that by mixing two volumes of gas hydrogen with one volume of gas oxygen an extremely hot gaseous fuel can be obtained, which can be used in many different ways and applied in all heating apparatuses working exactly like coal-gas.

The quantity of fuel used on the grill of furnace **2** is reduced to a minimum. This fuel can be: acetylen gas, wood, fuel oil, briquettes of every kind, they all do produce carbonic gas. Electricity too could be used for this heating, in this case it would be necessary to let in carbonic gas in body **5** by some mechanic means.

The industrial result obtained by this principle may be considered as new, by admission of a small quantity of carbon the fixation of the gas oxygen is obtained which allows to separate oxygen and hydrogen, to mix them afterwards again in order to obtain a gaseous fuel extremely rich in calories, and to use them according to suitable dosings as well for explosion motors, as for heating of boilers, as to inflate balloons.

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J. COUËLLE ET AL

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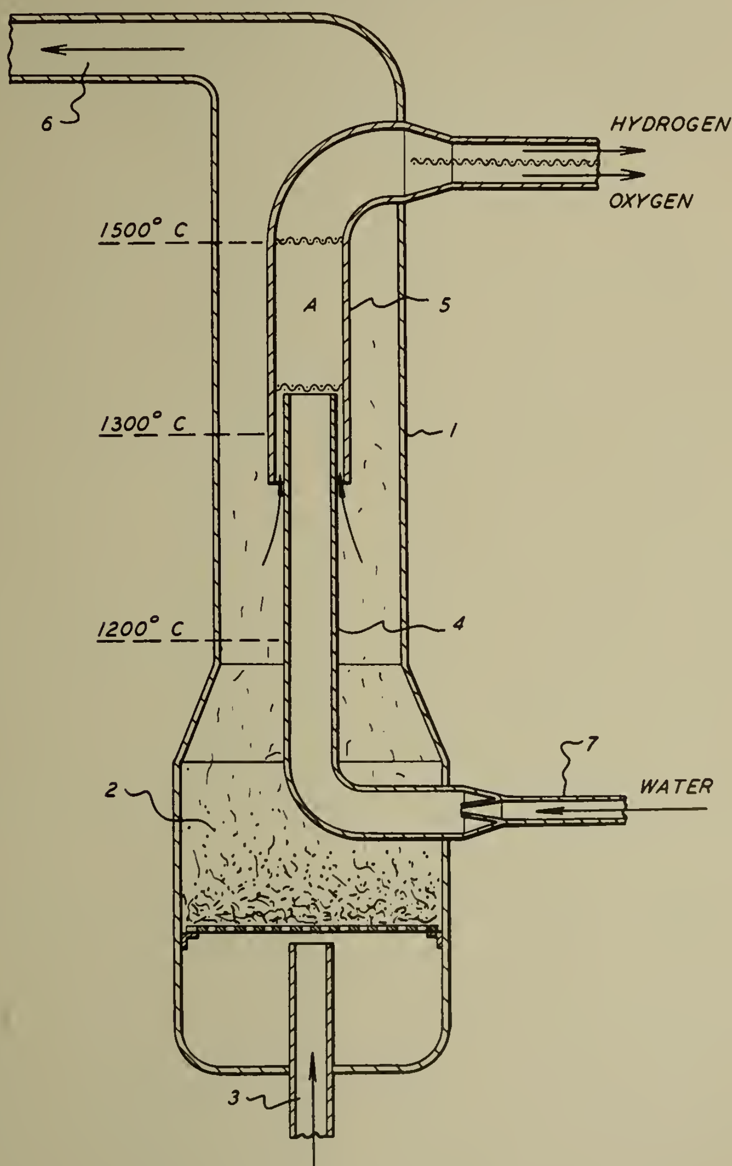

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ALIEN PROPERTY CUSTODIAN

EXPLOSION OR COMBUSTION ENGINES

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The present invention, which applies to explosion or combustion engines, provided with a carburetor or with a fuel injector, operating under fixed or variable working conditions, relates to an actuating device for opening or closing the throttles governing the admission of air or of carburetted gases supplied to these engines.

By this device the throttle or throttles are automatically actuated by a manometric relay influenced on the one hand by the partial or total atmospheric pressure and on the other hand by the partial or total vacuum prevailing in the admission conduct of the engine after the throttle or throttles. During normal operating conditions, only the action of the manometric relay prevails, without the intervention of any human force, nor of any other positive action whatever on the throttles taking place, the latter being consequently free to assume at any moment that position which depends on the value for which the partial vacuum is set in the manometric device, either by positive actuating means or by—for a given adjustment of this actuating means—the variations of working conditions resulting from the variations in the load of the engine.

The description which will follow, with reference to the appended drawing, given by way of non-limitative example, will allow a thorough understanding of how the invention can be embodied.

Fig. 1 is a diagrammatical sectional view of the manometric control device acting in conjunction with the throttle regulating the admission of the gases coming from a carburetor.

Figs. 2 and 3 represent a detailed view of a part of Fig. 1 in two different operating positions.

Fig. 4 is a perspective diagrammatical view of the manometric control device applied to the synchronized control of the throttles of several carburetors.

Fig. 5 shows this device, operating in conjunction with the throttle regulating the admission of air, in an engine to which fuel is supplied by an injector pump with volumetric output.

On Fig. 1, the throttle 1 controls the admission of the carburetted gases led towards the cylinders of an engine in the direction of the arrow 2 in the conduct 3 which constitutes the prolongation of a carburetor partially shown at 3*a*.

The throttle pivots about a spindle 1*a* and can be actuated by means of a lever 4 and a connecting rod 5 connected to the pin 6 of a rod 7 secured onto a piston 8. This piston 8 slides under air-tight conditions in a cylinder 9. The throttle 1 can be pushed into its closed position, and the piston 8 held against the stop 10, by the action of a spring 11 compressed between the cylinder 9 and an abutment integral with the rod 7.

The outer face of the piston is made to communicate with the atmosphere by means of an orifice 12 which may be calibrated so as to brake the movements of the piston.

On the inner face of the piston, a chamber 13 communicates with the admission piping 3, after the throttle 1, by means of a conduct 14 and a choke 15. The chamber 13 is, moreover, in communication with the atmosphere by means of a calibrated orifice 16 and, if desired, by a conduct 17 and a valve 18 which can be operated by the lever 19 and the actuating means 20. The valve 18 is shown in different positions in Figures 2 and 3.

The operation is as follows:

For the position of throttle 1 shown, the admission into the cylinders is a minimum and corresponds to a no-load, low speed operation of the engine. The partial vacuum existing in 3 is, under these conditions, very superior to the contrary stress of the spring 11. The valve 18, shown in an entirely open position, allows the admission of air which destroys the partial vacuum transmitted to 13 and thus permits the spring 11 to hold the piston 8 up against the stop 10 and the throttle 1 in its minimum admission position.

Operating valve 18 in order to close it (Fig. 2) will result in partially reestablishing the partial vacuum in the chamber 13. The piston 8 will then be displaced and at the same time the throttle 1 will progressively open. This opening action will be interrupted when the depression prevailing in 3, communicated to the chamber 13, tempered by the admission of air through the orifice 16 and and the valve 18, will counterbalance the resistance of the spring 11 for a determined position of the valve 18.

In the position shown in Fig. 3, the valve 18 is shown completely shut and the partial vacuum prevailing in 3 is thus entirely communicated to the chamber 13. This corresponds to full admission conditions.

Under these conditions, the stress of the spring 11 will, for example, be predetermined to counterbalance the partial vacuum prevailing in 3 and communicated, in 13, to the inner face of the piston, when the engine operated at its maximum rate and the throttle 1 is wide open

It is quite comprehensible that any reduction in the working speed resulting from an increase

in the power required of the motor will have for effect a drop in the partial vacuum in 3 and in 13. The spring 11 will no longer be counterbalanced and the piston 8 will be drawn forward thereby progressively shutting the throttle 1, which will result in a modification of the partial vacuum in 3.

The same operation will take place again for all positions of the valve 18 between the slowing down and full admission, which is equivalent to saying that a determined value of the pressure in the conduct 3 will correspond to each position of the said valve, whatever changes may occur in the speed and load of the engine.

Moreover, the partial vacuum communicated to 13 can be modified at will by calibrating the air admission orifice 16 so as to be proportional to the size of the orifice 15 which communicates the partial vacuum. This arrangement will allow to determine without difficulty the proper choice of the spring 11, or, for example, for any given spring, to control the said partial vacuum in 13 in order to cause the supply pressure in the engine in the conduct 3 to vary independently of the action of the valve 18.

These arrangements result in the obtention of the following advantages:

For instance, it is possible to maintain the partial vacuum after the throttle 1 constant at full load, this condition ensuring a more regular operation of the motor and a better utilization of the fuel.

The spring 11 may be chosen to answer definite aims: either because it is desired to limit the admission pressure to a determined maximum value, during full load operation; or because what is wanted is to completely fill up the engine at high duties with the possibility of automatically closing the throttle 1 for the low full load speeds in order to, for example, allow a better atomisation of the fuel by an increase in the speed of the air current at the level of the throttle 1. In this latter case, the strength of the spring 11 will be predetermined so as to be insufficient to counterbalance the partial vacuum at the maximum full-load rate and, as a result, the closing of the throttle as a consequence of load variations will occur only after a substantial decrease in the working speed.

Another advantage can be obtained by that type of control which allows, in the case of the so-called "floating" engines, the suppression of the abrupt opening of the admission and the transmission shocks which result therefrom at low, full-load speeds as a consequence of torque irregularities. This result can be easily obtained by giving the orifice 12 the proper calibration, with a view to breaking the too rapid acceleration of the piston 8 in conjunction with the displacements of the positive control means actuating the valve 18.

Fig. 4 diagrammatically represents three manometric devices acting in conjunction with three carburetors mounted on a common admission conduct. The branch conducts 17, 17′ and 17″ of the manimetric devices are connected one to another by a canal 21. A feeder, the length of which may, incidentally, vary, joins the canal 21 to the only valve 18.

Each one of the throttles operates in exactly the same manner as described above. The valve 18 simultaneously controls the three relays, atmospheric air being distributed to each one of the cylinders 9, 9′, 9″ by means of the piping 22, 21, then 17, 17′ and 17″. The feeder 22 may be given a sufficient diameter to avoid any loss of load, and may be given a convenient length to simultaneously obtain the possibility of governing at a distance and a transmission free from mechanical play, thus ensuring a perfect synchronization in the actuating of the throttles. This arrangement naturally applies in the case of several motors operating synchronously and controlled by a single valve 18.

In the embodiment shown in Fig. 5, the conduct 3 supplies pure air, in the direction of the arrow 2, to an engine provided with an injector in which the fuel is sent into the cylinders by a pump 25 and conducts 26, 26′, 26″ and 26‴. The throttle 1 is connected to the same organs as in Figures 1 and 2. Moreover the control lever 19 of the valve 18 is connected by a rod 23 to the axis of a rack 24, the displacements of which, between the positions 27 and 28, control the variations in the discharge of the pump 25. The extreme points 27 and 28 correspond respectively to the points 29 and 30 of the total displacement of the lever 19. Finally, a capsule 31, sensitive to temperature variations controls the movements of an arrow 33 which can vary the cross-section of the orifice 16 connected to the chamber 13 by an appropriate canal 32.

The operation of the manometer control means of the throttle 1 remains the same as that described in the preceding examples and ensures, in addition to those advantages already indicated, the automatic control of the air-fuel ratio in function of speed and load variations of the engine.

For, as has been explained hereabove, the pressure, for all positions of the valve 18, assumes a constant value in the conduct 3, whatever may be the working speed variations resulting from changes in the load. Consequently, if, on the one hand, the connection between the control means of the valve 18 and that of the rack 24, which regulates the output of the pump 25 is arranged in such a way that a suitable fuel supply corresponds to each value of the air pressure in 3 determined by a given position of the valve 18, and if, on the other hand, for this same position of the valve 18, the fuel supply discharged by the injector pump remain proportional to the working speed of the engine, the constancy of the air-fuel ratio will automatically be maintained by the action of the piston 8, said action being a function of the working speed variations resulting from the load variations of the motor. This same result will obviously be obtained for all positions of the control means actuating the valve 18 and the rack 24.

On Figure 5, the device ensuring the liaison between the control means of the valve 18 and the rack 24 of the pump is supposed to be a connecting rod 23. Such a connection means may not allow to obtain the suitable relation between the displacements of the valve 18 and those of the rack 24. To obtain the desired relation, which relation or law is itself a function of the shape of the valve and of the constitution of the pump, it is possible to ensure the liaison between the control means of the valve and the rack 24 in any suitable manner, by means of an adequate profile cam for example. This cam may be, for example, mounted on the axis of the valve 18 and will act on the rack 24 by means of a rod resting on its profile.

A liaison ensured by means of a connecting rod may also be maintained by giving the valve opening or port 18 an appropriate shape so that the

cross-section of the passage way varies according to a determined law.

Finally, it would be possible to arrange in the same manner the internal control means of the pump.

Moreover, the variations in the air supply which may be the result of temperature changes will be rectified by the action of the capsule **31** and the arrow **33** which, by increasing or diminishing the size of the orifice **16** for the admission of air will modify the motive partial vacuum acting at all times on the piston **8** and, by so doing, will diminish or increase the air supply in **3** in relation to the temperature.

The embodiments shown do not in any way limit the invention but are only given by way of example.

In particular, the piston **8** may be constructed in all sorts of ways or even replaced by a membrane or bellows without departing, by so doing, from the scope of the invention.

The same remark applies to the liaison means between the piston **8** and the throttle, which connecting means may consist in a rack or any other suitable mechanical device.

The valve **18** which proportions the atmospheric pressure inside the manometric device may be different from the tap represented on the drawing; it may be constituted by a needle valve or by any other appropriate device.

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C. E. BONNIER

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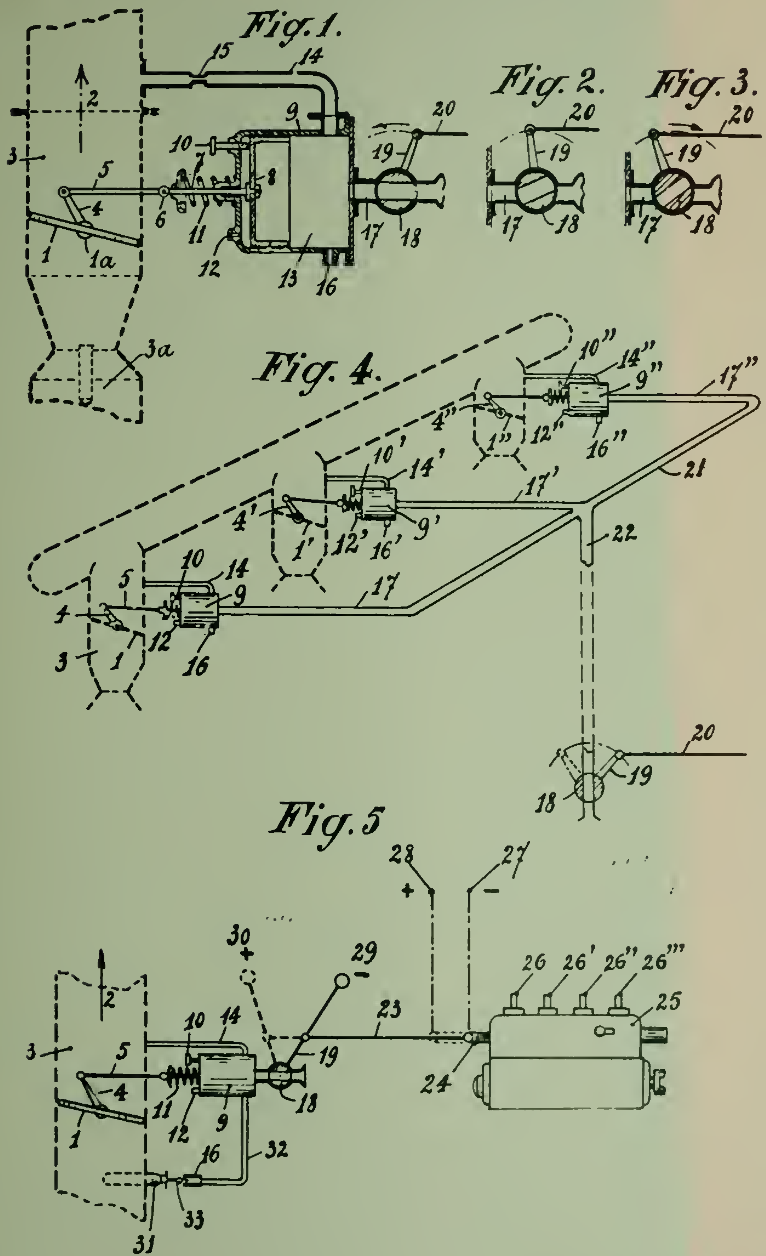

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ALIEN PROPERTY CUSTODIAN

SERIES-PARALLEL AND PARALLEL CONNECTIONS FOR DIRECT CURRENT MOTORS WITH SPLIT UP EXCITING WINDING

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Application filed March 26, 1942

This invention relates to series-parallel and parallel connections for direct current motors with split up exciting windings.

It is well known that one of the methods for the regulation of the speed of electric locomotives and rail motor cars working with direct current consists in varying the field of the field magnets of the traction motors for instance by one or the other of the following means:

Connection of resistances in parallel with the field magnets;

Separated feeding of the field magnet windings by the mains with interposition of variable resistances;

Supply of current to the field magnet windings by an independent and variable source of current (battery, motor-generator unit and the like).

As regards this latter means it is known, more particularly, to regulate the speed of series motors with split up exciting winding or of compound motors by means of an auxiliary dynamo driven by a motor supplied with current from the mains and shunted on a fraction of the split up exciting windings (see Figure 1, where M designates the armature of the motor, m and m' the exciting windings of the same, and G the dynamo).

But if it desired to apply this method in the case of a plurality of similar motors connected in parallel or in series-parallel, one is led to the use of as much auxiliary dynamos as there are motor groups connected in parallel, which renders the plant cumbersome, expensive and difficult to control.

It is true that it would be possible, as shown in Figure 2, to use a single dynamo G connected with the united ends of the complementary fractions m'^1, m'^2, m'^3, m'^4 of the exciting windings m^1, m^2, m^3, m^4 of each of the branches M_1, M_2, M_3, M_4 connected in parallel. But with such an arrangement it is obvious that it would be impossible in the practice, and in any case the more difficult the greater the number of branches connected in parallel would be, to obtain an equal distribution of the current in the various complementary exciting windings. Furthermore, the space required by the apparatuses would not be materially diminished.

The present invention has precisely for its object to provide a particular method of connection for any number n of motor distributed in z groups or branches connected in parallel and comprising each

$$\frac{n}{z}=u$$

motors connected in series, the said connection supplying supplementary characteristics of the series form which increase the number of the regulation curves of the machine and permit, furthermore, to perform the shunting by means of auxiliary dynamos or of resistances in a range which is more extended than with the typical connections and this with important constructive advantages.

According to the invention, the exciting winding or field winding of each motor being split up in two fractions, the one of them is, for each motor, traversed by the current which flows through the branch in which the armature and the changing over windings of the motor under consideration are inserted, while, on the contrary, all the other fractions, which will be called "complementary fractions," without prejudicing their relative value with respect to the first named fractions, are combined with another and connected in series in order to form a single chain for all the motors and, according to the case, this chain is either connected in series with respect to the whole of the various branches which are connected in parallel, the said chain being then, according as it is shunted or not shunted, traversed by the whole or a part of the sum of the currents which flow through the above mentioned branches, or connected in a separate manner and supplied exclusively by one or more auxiliary dynamos the whole or a part of the exciting windings of which is traversed itself by a current which is proportional to the sum of the currents which flow through the branches connected in parallel.

In the first case—and always according to the invention—the regulation of the speed of the machine is performed by connecting either one or more auxiliary dynamos or a variable resistance in shunt with the complementary exciting chain, the current which flows through the said chain being then either the algebraic sum (case of the auxiliary dynamo) or the arithmetical difference (case of the resistance) of the currents which flow, on the one hand, through the whole of the branches which are connected in parallel (armatures and the first fraction of exciting windings) and, on the other hand, through the above mentioned shunt respectively.

In the second case the current which flows through the complementary exciting chain is solely a function of the sum of the currents which flow through the various branches (armatures and the first fraction of exciting windings).

In the appended drawing, which shows amongst others and by way of example a plurality of forms of execution of the invention.

Figure 3 is a diagram of a connection according to the invention in which n motors are distributed in z branches connected in parallel and comprising each u motors connected in series.

Figure 4 shows jointly with the curves of the normal series-motor the curves: stress, speed in

function of the intensities, obtained with the connection according to Figure 3.

Figure 5 is a diagram similar to that of Figure 3 and comprising a shunting for each auxiliary dynamo.

Fig. 6 is a diagram similar to the foregoing one but with a shunting for each variable resistance.

Fig. 7 is a diagram showing the separated supply of the complementary fields by means of an auxiliary dynamo the exciting windings of which are traversed by the whole of the current which flows through the z branches.

Fig. 8 is a diagram which is a modification of the foregoing one.

Figure 9 is a modification of the connection according to Figure 3.

In the connection according to Figure 3, the n motors of the plants are grouped in z branches which are connected in parallel and each of which comprises u motors represented by their armatures 1—u and the fraction $1'$—u' of the exciting winding which remains constantly in series with its armature regardless, moreover, of its position in the series branch under consideration. The last motor is designated by n and the corresponding fraction of exciting winding is designated by n'.

According to the invention the complementary windings $1''$—n'' of the whole of these motors are connected in series with respect to one another so as to form a single common chain connected at the common point up or down the line of the various branches connected in parallel so that the current which flows through the said chain $1''$—n'' is equal to the sum of the currents which flow through each of the said branches 1—z. The whole is inserted between the positive and negative terminals of a usual supply with direct current.

In Figure 3, as well as in the following figures, it has been supposed that the chain is connected at the above mentioned common point down the line.

Of course, the constitution of the complementary windings is such that the flow of the current (sum of the currents of the branches in parallel) causes no destruction in this part of the motors.

The operation of this connection is as follows (see Figure 4):

a being the number of turns of the winding fraction $1'$ of the motor 1 and b the number of turns of the complementary winding $1''$ of the said motor, and I designating the current which flows through each of the branches 1—z, it is known that for a normal series motor the field would be a function of $(a+b)I$, while in the above described connection it will be, of course, a function of $(a+zb)I$; that is to say that for one and the same intensity I flowing through the armature, the well known point of normal working (A, B) of the characteristic $V=f(I)$ and $F=\varphi(1)$ of the typical series motor will go through a point (A_1, B_1) characterized with respect to the foregoing one by the fact that A_1 is below A and B_1 below B.

For the different values of I one will obtain points A_1 and B_1 arranged in a similar manner with respect to the above mentioned manner, these different point being group on both curves V_1 and F_1 respectively which are shown in chain lines in Figure 4 where the normal curves V and F on the contrary are shown in full lines.

According to the respective positions of the curves F_1, V_1 with respect to the curves F, V, those skilled in the art will immediately conceive that the regulation zone which is possible for every shunting is increased by the hachured areas.

The connections according to Figures 5 to 8 are modifications of the method for obtaining economical curves stress-speed from the fundamental curves F_1, V_1.

In the connection according to Figure 5 which is obtained from the Figure 3, the means used for obtaining the above mentioned curves consists in using one or more dynamos grouped in series, in parallel or in series-parallel and connected across the terminals of the common series-chain $1''$—n''.

On the drawing only one dynamo G has been shown with its driving motor M_0 connected in a known manner across the terminals of the supply mains (+ and −).

The dynamo G can be disconnected by the opening of a contacting switch c and its regulation is effected in a known manner (not shown), for instance by means of a separated excitation eventually, according to the form of the curves which are to be obtained, with the addition of a supplementary winding traversed by the whole or a part of the current which flows through the complementary exciting chain $1''$—n''.

When normally working the operation is as follows:

If one supposes that the contacting switch c is open, the whole plant works like a group of motors connected in series-parallel with reinforced fields, as results from the above given explanations.

On the contrary, if one supposes that the contacting switch c is closed and that the dynamo G is not excited, the current issued from the branches connected in parallel will be partly shunted and flow through the said dynamo which then works like a constant resistance.

Now, if the dynamo receives a predetermined excitation independent from the current which flows through the armatures, according as the voltage at the terminals of the said dynamo will be higher or lower than the voltage at the entrance into the complementary chain $1''$—n'', the current flowing through the said chain will be reinforced or diminished without it being possible, however, to bring it to nought again, since for a value nought of the voltage + of the dynamo (case of the maximum output in this latter) one would simply obtain a shunting of a certain value of the armatures connected in series.

In the case when the excitation of the dynamo should be dependent from the current which flows through the armature, the voltage at the terminals of the said dynamo would vary with the said current and one would obtain a curve having a form which would also be interesting, but different from the former.

In order to obtain not only the value nought in the armatures of the chain $1''$—n'' (shunting curve of series-motors working solely with the windings $1'$—n'), but also the change of direction of the current in the said armatures, it will be possible, by known means, to reverse the polarity of the dynamo. From this moment the more the voltage difference at the terminals of the latter will be increased, the more the resulting current which normally flow through the complementary chain will be diminished until one obtains the reversal of the said resulting current, i. e. the working with recuperation.

If one wishes to maintain the integral form of the characteristic of series-motors it is possible, as shown in Figure 6, to connect an adjustable resistance R across the terminals of the complementary chain I''—n'' instead of the auxiliary dynamo G provided for in the connection according to Figure 5.

The operation is self-explaining.

Of course, such an arrangement excludes the recuperation with the sole adjustment of the resistance R.

From the constructive point of view and from a certain output the dimensions and weights of the auxiliary dynamo or dynamos of the arrangement according to Figure 5 would exceed the values which can be admitted for rolling stock. One is then led to contemplate the use of a different connection shown in Figures 7 and 8.

According to Figure 7 the series-chain formed by the complementary field windings I''—n'' is supplied separately and exclusively by the auxiliary dynamo G which, being independent from the armature circuit, has no longer to sustain the flow of an important fraction of the sum of the currents of the parallel branches and can, therefore, receive dimensions which are much more reduced than in the connection according to Figure 5. Then the z parallel branches could be simply and solely connected with the negative and positive terminals of the supply.

However, (and this is the diagram shown in the Figure), without a corrective, the connection which would be obtained in this manner would represent the integral connection of motors with a form of compound characteristics. Now, it can be necessary, in certain traction cases, to obtain curves the forms of which are much nearer to series-characteristics.

It is easy to come nearer to the said forms by providing the dynamo with an adjustable exciting winding traversed by the whole current which flows through the parallel branches.

As shown in the said Figure 7, it is sufficient to connect an adjustable resistance r in parallel with the exciting winding E.

It is now easy to conceive that the variation of the voltage at the terminals of the dynamo and, by way of consequence, the current which flow through the complementary chain I''—n'', will be proportional to the intensity which flows through the above mentioned winding E. More particularly, for a predetermined adjusting position of the resistance r, the direction of the variation of the current in the chain I''—n'' will be the same as in each of the armatures of the motors.

It is obvious that the working with recuperation would be obtained by the addition of a second separated winding E_1 to the dynamo; then the winding E, which is maintained in the circuit for the traction running, could possibly be eliminated for the working with recuperation by opening a switch d.

From the point of view of practical construction and for outputs which are higher than a certain value, the kind of connection of the winding E and of the resistance r can lead to dimensions and weights which are prohibitive.

The modification according to Figure 8 (in which the reference letters designate the same parts as in Figure 7) meets this disadvantage by the fact that only a fraction of the whole current is permitted to pass through the winding E, the whole current flowing through a resistance ρ having reduced dimensions and with the terminals of which the said winding E and its adjusting resistance r are connected.

For the recuperation and the stability of the working this latter kind of connection is the same as the former.

More particularly, as regards the electric stability of the connections according one or the other of the Figures 7 and 8, the said stability is proved by the fact that for each variation of the voltage in the mains the intensity of the current in the field windings I'—n' and I''—n'' tends to vary in the same direction as in a series-motor.

Although the invention has been described while supposing that a fraction of the field winding of each of the n motors remains constantly in series with its armature in the branch to which the latter belongs, it appears with evidence that in conformity with what is shown in Figure 9 the windings I''—n'' could be included, in order to obtain forms of characteristics different from those which are obtained with the connection according to Figure 3 and shown in Figure 4, in the complementary chain I''—n'' so that the totality of the exciting fields of the motors would be connected in series, thus forming a single exciting chain receiving the sum of the currents which flow through the parallel branches which would then comprise solely in series the armatures of the motors always connected with their auxiliary changing over windings respectively. Of course, the shunting through auxiliary dynamos or through a resistance would be effected exactly as in the former case according to Figures 5 and 6.

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SERIES-PARALLEL AND PARALLEL CONNECTIONS FOR DIRECT CURRENT MOTORS WITH SPLIT UP EXCITING WINDING

Filed March 26, 1942

Serial No. 436,356

3 Sheets-Sheet 1

Fig. 1

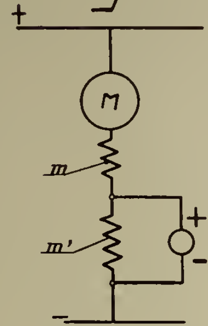
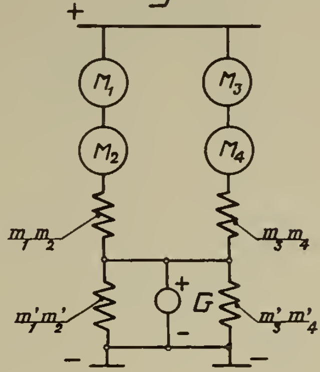


Fig. 2



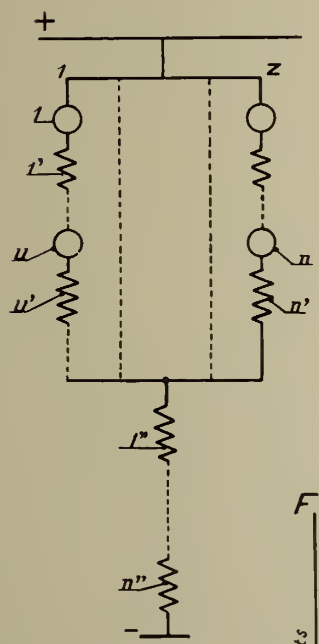
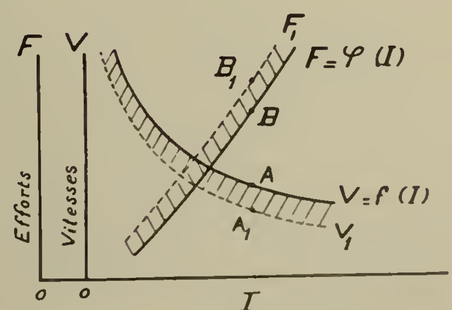


Fig. 3

Fig. 4



I (pour 1 moteur) = Intensité parcourant un induit

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SERIES-PARALLEL AND PARALLEL CONNECTIONS FOR DIRECT CURRENT MOTORS WITH SPLIT UP EXCITING WINDING

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Serial No. 436,356

3 Sheets-Sheet 2

Fig. 5

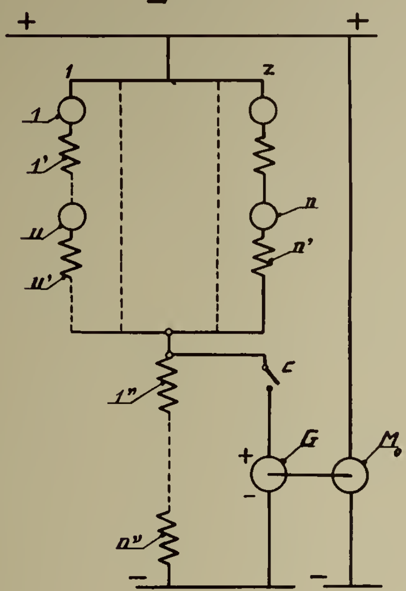
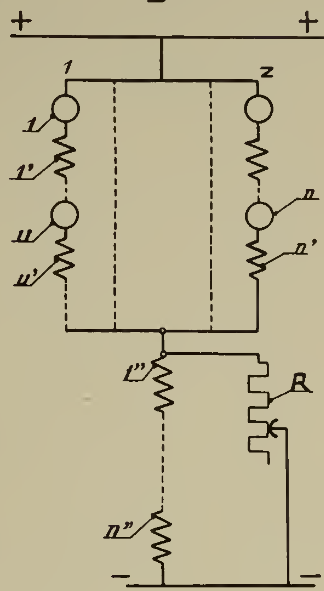


Fig. 6



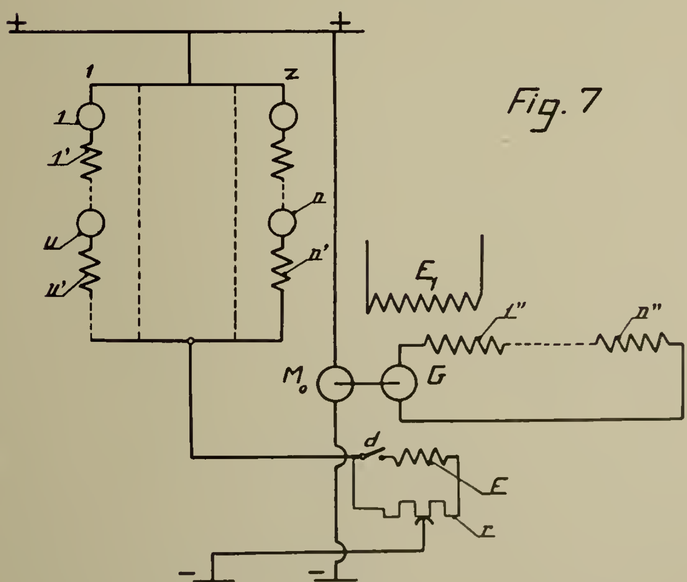


Fig. 7

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Serial No. 436,356

3 Sheets-Sheet 3

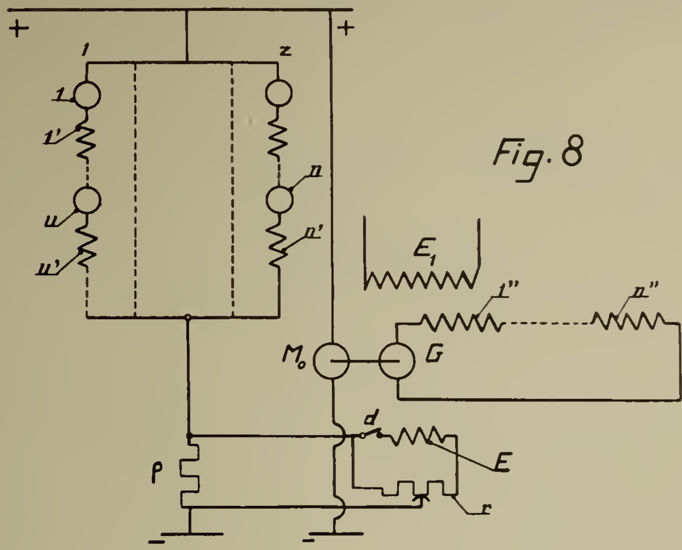

Fig. 8

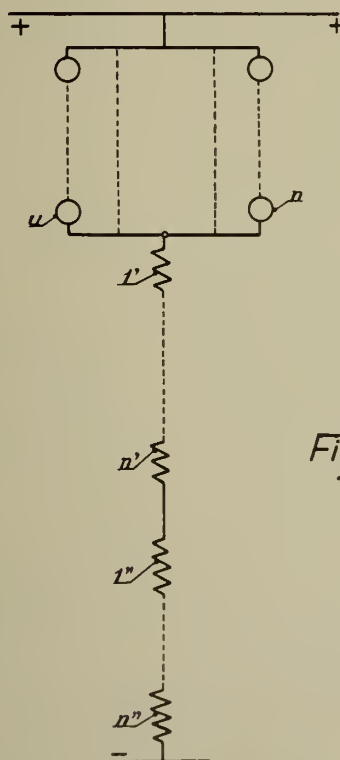

Fig. 9

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ALIEN PROPERTY CUSTODIAN

FUEL FOR MOTOR VEHICLES

Jean Leon Maurice Frejacques, Paris, France; vested in the Alien Property Custodian

No Drawing. Application filed April 7, 1942

Liquid ammonia has already been proposed as a replacement fuel for motor vehicles. It presents a number of advantages making it worth while to consider its use. It is already being produced on a very large scale, and eventually it may be made solely from air and water, with the use of hydraulically produced electric energy, i. e. from raw materials which are present practically unexhausted in nature. Compared to hydrogen and other compressed gases, ammonia has the advantage of requiring for storage only comparatively low pressures, so that the dead weight to be transported is considerably reduced. In case of accidents, the dangers of explosion are further considerably reduced while the tank leakages cannot be ignited, thus reducing the dangers of fire.

The calorific value per litre of the ammonia fuel mixture is, however, less than that of gasoline mixture, and its use in an engine therefore brings about a corresponding decrease in the power output.

It is also known that ammonia, used alone, will burn badly in an ordinary engine, and that, for obtaining an absolutely correct operation, it is necessary to add to it a small proportion, of about 5 to 15% of a combustible gas, such as hydrogen, CO or town gas. This necessity, however, sets up, in use, a serious complication, the above gases having to be stored in separate, high pressure containers.

For overcoming this difficulty, it has already been proposed to break up part of the ammonia into nitrogen and hydrogen by causing it to pass over a suitable catalyser, but this necessitates the installation, on board the vehicle, of rather complicated devices and makes the starting laborious.

The present invention concerns another means for overcoming the said difficulty. This means is based upon the fact that acetylene is comparatively very soluble in liquid ammonia and that the applicant has found that it is possible to obtain easily mixtures containing up to 20% of acetylene by weight without unduly increasing the vapour pressure of the liquid ammonia. It has further been found by the applicant that the mixtures containing at least 3% of acetylene by weight will burn quite correctly in an ordinary engine and that the presence of acetylene, while increasing the calorific value of the cylinder charge, will advantageously compensate for the small loss of power resulting from the use of liquid ammonia alone. From the latter point of view, it may be interesting to employ mixtures very rich in acetylene, the contents of the latter amounting up to about 20%, while the corresponding pressures are quite reasonable and the dangers of explosion are very low. In practice however, an acetylene contents ranging from 10 to 12% by weight is very adequate. At 25°C, mixtures of this sort have vapour pressures of the order of 9 to 10 kg/sq cm for pure liquid ammonia, and the partial pressure of the acetylene in the gas, in equilibrium with the liquid, is only 3 to 4 kg/sq cm. The mixtures may be stored without difficulty in ordinary containers for liquid ammonia.

For use, it is advantageous to arrange for the ammonia tank to be operated as a siphon, and to cause the drawn liquid to pass into a small evaporator heated by the exhaust gases. The evaporator may, besides, consist simply in a pipe of reduced cross-section, wound around the exhaust pipe and covered with asbestos tress.

The distribution of fuel to the engine may be effected by means of one of the many existing types of expanding and dosing devices for compressed gases existing on the market, some of which are very easy to install, without eliminating the possibility of operation with liquid fuels. The alteration to be made to the vehicle is therefore comparatively simple and cheap. Lastly, the starting of the vehicle is easy and does not require the use of liquid fuels, the mass of the apparatus being sufficient for supplying the calories required for evaporating the ammonia up to the moment when the exhaust pipe has reached its working temperature.

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Serial No. 438,395

ALIEN PROPERTY CUSTODIAN

COMPOSITE ELECTRIC CONDUCTOR

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Application filed April 10, 1942

As is known, the substitution of aluminum for copper in the manufacture of electric conductors and particularly of aerial or overhead conductors is a technical problem the solution of which can only be found by studying the dual question of the electric conductivity and tensile strength of the substituted metal.

In an endeavor to solve this problem, it has been previously proposed to manufacture composite electric conductors made up partly and in suitable proportions of galvanized steel wires and partly of pure aluminum wires. However, such proposals have not led to a satisfactory solution of the problem on account of the discrepancy in behavior due to the difference of nature and properties of these two categories of wires.

An object of the invention is to provide as a new article of manufacture a new or improved composite electric conductor made up of elements possessing higher homogeneousness and at the same time a high tensile strength and a suitable resistivity.

Another object of the invention is to provide a new composite electric conductor made up of differentiated leads so selected as to possess substantially the same polarisation voltage, thereby preventing a corrosion torque from arising therebetween.

A further object of the invention is to provide a new composite electric conductor made up of leads having substantially the same coefficient of expansion, thereby lessening the influences due to temperature fluctuations.

A still further object of the invention is to provide a new composite electric conductor endowed both with high lightness and prolonged weather-proofness.

With these and such other objects in view as will incidentally appear hereafter, the invention comprises the novel features that will now be described with reference to the accompanying drawing exemplifying the same and forming a part of the present disclosure.

The drawing is a diagrammatic cross sectional view of a composite electric conductor made according to the invention and comprising by way of example seven leads or strands each having a circular shape in cross section and arranged longitudinally side by side in tangential relation as shown to form a bundle. Four of these leads designated by *a* and left blank on the drawing are assumed to be made of pure aluminum, while the three remaining leads designated by *b* and identified by hatchings are assumed to be constituted by a light alloy mostly made of aluminum but incorporating a suitable percentage of one or several alloying ingredients capable of imparting to said alloy greater mechanical strength while not appreciably curtailing its properties as regards conductivity and resistivity.

The leads or wires *a* and *b* having the aforesaid differentiated characters may be advantageously so distributed that each of the leads *b* possessing higher strength contacts only with leads *a* possessing higher conductivity. This arrangement provides for a better distribution of the qualities of both lead elements throughout the clustered bundle-like structure.

The number of leads *a* and *b* as well as their cross sectional shape and size may vary of course to suit practical requirements in the installation of electric lines particularly in the case of aerial or overhead lines.

Moreover, the leads *a* and *b* may be juxtaposed either rectilinearly, helically or in any other suitable fashion, for example twisted together like the strands of a rope or cable.

The leads *a* and *b* may be left bare or provided with insulating coverings or sheaths, and they may be furthermore held together by any known clamping means such as clips, straps, thimbles, plugs or sockets arranged at suitable intervals and adapted to be supported by any convenient brackets or carriers mounted on posts or otherwise.

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COMPOSITE ELECTRIC CONDUCTOR

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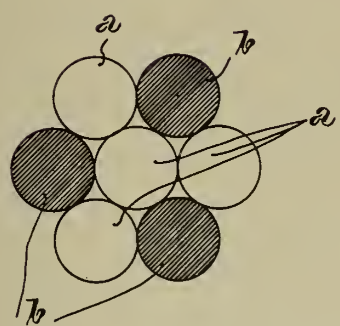

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By Haseltine Lake & Co.
Attorneys.

Published June 1, 1943

Serial No. 438,410

ALIEN PROPERTY CUSTODIAN

METHOD AND FURNACE FOR ELECTRICALLY MELTING GLASS

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Application filed April 10, 1942

The present invention relates to methods and furnaces for electrically melting glass by using a tank or basin fitted with electrodes connected to a suitable source of electric current and so arranged that an arc is struck between them for generating heat so as to liquefy the mass of glass or vitreous material to be melted.

An object of the invention is to provide an improved method for melting glass with the aid of a tank or basin of the aforesaid type, this method residing in a novel or improved mutual arrangement of the electrodes and leads and in the novel manner of feeding current thereto with a view to setting up under the influence of the currents through the leads electrodynamic forces capable of re-acting upon the circulation of the mass of glass being melted, such circulation being due as is known to the different thermal effects on the several portions of said mass and taking place on the thermosyphon principle.

Another object of the invention is to provide an improved electric furnace of the aforesaid type comprising such a novel arrangement of the electrodes and leads feeding current thereto as to generate parallel currents capable of favorably influencing by an attractive or a repulsive electrodynamic effect the heat responsive circulatory motion of the mass of molten glass and of enabling a metal of finer quality to be obtained.

Another object of the invention is to provide a novel or improved electric furnace of the aforesaid type comprising such a new combination of electrodes set and associated pairwise face to face and of return leads connecting them back to a source of suitable current as to foster an electrodynamic action which will impart to the mass of molten glass circulatory impulse upwardly from the central hot point in the tank and downwardly back to said hot point.

A further object of the invention is to provide in an electric furnace of the aforesaid type such an improved arrangement of the electrodes and leads connected thereto as to localize adjacent the surface of the pool of molten glass such a heat evolution as to carry out and preserve fusion thereof under advantageous conditions.

A still further object of the invention is to provide in an electric furnace of the aforesaid type a novel arrangement of horizontally slidable and adjustable electrodes projecting well into the tank to a position adjacent its centre so as to concentrate the current lines in its middle region.

With these and such other objects in view as will incidentally appear hereafter, the invention comprises the novel steps as well as the novel construction and combination of elements that will now be described with reference to the accompanying diagrammatic drawing exemplifying the same and forming a part of the present disclosure.

In the drawing:

Figure 1 is a longitudinal sectional elevational view of an upwardly open glass-melting tank or basin, assuming the electrodes to be omitted, the section being taken on the line I—I of Fig. 2.

Figure 2 is a plan view corresponding to Fig. 1.

Figure 3 is a transverse sectional view on the line III—III of Fig. 1.

Figure 4 is a plan view of a slightly modified glass-melting tank or basin showing three pairs of electrodes engaged through its opposite longitudinal walls and arranged with their tips face to face pairwise.

Figure 5 is a plan view showing a tank or basin as illustrated in Fig. 4 and the wiring provided between the respective electrodes and the terminals of the windings of a three phase transformer.

Figure 6 is a plan view similar to Fig. 5 showing a slightly different way of connecting the electrodes to the terminals of the transformer windings.

Figure 7 is a transverse sectional view of a closed glass-melting tank or basin showing an arrangement of the leads connected to a pair of electrodes arranged face to face.

Figure 8 is a view similar to Fig. 7 showing a slightly modified arrangement of the leads.

Like reference characters designate like parts throughout the several views.

The electric furnace shown comprises a rectangular melting tank or basin **2** of elongated shape which may have a construction similar to that of commonly built glass furnaces. In accordance with current practice, the tank or basin **2** is advantageously provided at one end with an inlet spout or "dog house" such as **19** defining a channel **25** through which is poured the mass of glass or vitreous material **26** to be molten or liquefied in the tank. At the opposite end of the tank may be provided as shown in Fig. 4 a "working basin" **27** defined by an arcuate end wall and communicating with the main space of the tank by an aperture **28** which may be in the form of a weir formed in a partition **30** separating the two basins from each other. The tank may be provided, moreover, with such suitable contrivances as a glass-gathering pipe

which are not shown as they form no part of the invention.

The electrodes 3, 4, 5, 6, 7 and 8 through which the electric current is led may be made of carbon or graphite and are grouped into two sets, each comprising three electrodes projecting through the respective longitudinal walls of the basin 2. The electrodes are so arranged as to inwardly protrude well into the basin 2 and into the pool of molten glass slightly below its upper surface.

Each electrode is so mounted as to be horizontally movable along its axis so that it can be engaged to a greater or lesser extent into the enclosure defined by the surrounding walls of the basin 2. Each electrode may be cooled by any suitable form of water box (not shown) which forms no part of the invention.

In the illustrated embodiment, each of the six electrodes is connected to the terminals of the secondary windings of a three phase transformer 10 so that they receive current impulses which by a phenomenon of diffuse conductivity flow throughout the mass of glass being molten and heat the same by the known direct Joule action.

The electrodes are located so that their inner tips face each other as shown. The gaps between their inner tips may vary according to requirements and such gaps may also vary from one pair of electrodes to another. It will be understood that provided the electrodes project far enough into the tank 2 so as to leave between their inner tips comparatively short gaps, the current lines will be closer to one another between said tips than between the portions of the electrodes adjacent to the periphery of the tank. Consequently the evolution of heat is greater in the middle or central portion of the tank. This promotes the formation of a heat-responsive rising stream through the central portion of the mass of glass being molten and fosters the required circulatory motion thereof as depicted by the arrows in Figs. 1, 2 and 3.

As is well known, in an electric furnace of this class, it is generally advantageous to hasten this circulatory motion of the hot molten glass so as to use the latter as a vehicle carrying by convection the heat which is required for heating the fresh batches such as B of glass material charged into the basin by the spout 19. As will be understood, should this convection action be reduced, the subjacent layer of glass material is cooled by contacting with said fresh batches and thus becomes less conductive of the electric current so that the melting process is slowed down and the general efficiency of the furnace is curtailed.

In the electric furnace according to the invention, the mutual arrangement of the electrodes and leads respectively connected thereto is such as to set up electrodynamic actions which accelerate the heat responsive circulatory motion of the glass being molten by adding their effect to those of heat generated by direct Joule action as above described.

It is a well known electrical notion that two similarly directed parallel currents attract each other in direct ratio of the product of their intensities and in inverse ratio of the distance between them. If, however, the currents are oppositely directed, they repulse each other.

Where three phase alternative current is used to operate such a furnace, the parallel currents are similarly directed during two sixths of a cycle and oppositely directed during four sixths of the same cycle so that, as will be readily understood, the currents of two of the three phases respectively designated by I, II and III in Figs. 5 and 6 repulse each other most of the time. It follows from this fact that the repulsive action is preponderating.

The wiring should be effected preferably by taking into account the following explanations given in connection with the showings of Figs. 5 and 6: Assuming the source of alternating current to be a transformer such as 10 having six output terminals on its three secondary windings, a primary way of effecting the wiring is that shown in Fig. 5 wherein the three electrodes 3, 4, 5 located on the near side of the tank 2 are connected to the three positive terminals while the three electrodes 6, 7, 8 located on the far side of the tank are connected to the corresponding negative terminals of the respective transformer windings. It will be understood that between the electrodes 5, 8 tapped to phase I and the electrodes 4, 7 tapped to phase II is set up a repulsive action. However, as the glass between the electrodes 5, 8 is cooler than the glass between the electrodes 4, 7, it is less fluid and movable and thus drives the hotter glass towards the middle of the tank. This arrangement is not fully satisfactory. In order to obtain better results, the wiring shown in Fig. 6 should be preferably used. It will be seen that the middle electrode 4 located on the near side of the tank 2 is connected to the negative output terminal of the corresponding transformer winding, while the middle electrode 7 located on the far side of the tank is connected to the positive output terminal of said winding. This provides a so-called staggered coupling of the several electrodes with the source of current. Owing to this coupling, an attractive action is set up which draws the less movable cooler glass from between the electrodes 5, 8 towards the hotter glass between the electrodes 4, 7 and thus fosters the circulatory motion depicted by the arrows in Figs. 1, 2 and 3. The hotter portion of the glass in the tank is thus caused to come into contact with the fresh batches B of glass material introduced through the spout 19 into the tank and to preheat them. This improves the thermal efficiency of the furnace and accelerates the melting process without involving extra current expenditure.

The wiring arrangement shown in Fig. 6 presents the further advantage of providing for a satisfactory balance of the phase loads assuming the extent to which the electrodes project into the tank to be equal. Another advantage is that between the phases only half the tension prevails and the current longitudinally flowing along the tank walls is weaker since the furnace operates on the six phase principle. On the whole, this connecting system is therefore particularly advantageous.

An alternative way of connecting the electrodes would consist in negatively tapping the electrode 3 and positively tapping the oppositely located electrode 6. This alternative is not shown but it is so obvious to any one skilled in the art that it can be readily understood and carried into practice without requiring a special illustration. The advantage of this alternative arrangement lies in a still stronger acceleration of the circulatory motion of the glass as shown by the arrows in Figs. 1 to 3, because in this case a repulsive action is set up between the middle and right hand side phases II and III while a conjunctive action is set up between phases III and I. However, in order to ensure proper op-

eration and suitable load and phase balance, the extents to which the electrodes project into the tank must be then rendered different, for example by means of adjusters such as the one diagrammatically shown at A in Fig. 4.

An important feature resides in the fact that the leads feeding the current to the pairs of oppositely facing electrodes are so arranged as to lie over the major portion of their length in substantial parallelism with said electrodes so as to create electrodynamic actions capable of further promoting the circulatory motion of the glass.

By way of example, assuming the back lead from the middle electrode to the negative terminal of the transformer winding to extend underneath the furnace hearth, it will be understood that a repulsive action is generated which strongly repels the molten glass upwardly in the middle region of the tank since in this region more intense currents flow through the glass. This further hastens the circulatory motion and homogenizes the mass of molten glass.

The foregoing action may be still further enhanced by so shaping the back lead as to form one or more loops such as shown at 29 in Figs. 7 and 8, said loops extending parallel with the facing electrodes and passing over and under the tank 2 so as to surround it. The wiring as shown in Fig. 8 is so devised as to cause the electrodynamic effect of the current to produce a braking action capable of slowing down the circulatory motion of the glass where, somehow, it is too rapid and this would risk to jeopardize the quality of the resultant glass after completion of the melting process.

The above described electrodynamic effect may be produced also in glass furnaces heated by means of gas, coal, fuel oil or otherwise.

Minor constructional details of the improved furnace might be changed without departing from the scope of the subjoined claims.

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METHOD AND FURNACE FOR ELECTRICALLY MELTING GLASS

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Serial No. 438,410

Fig. 1

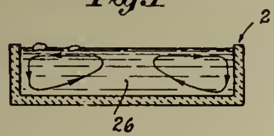


Fig. 3

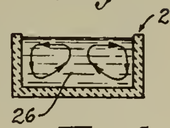


Fig. 2

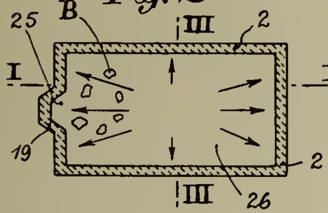


Fig. 4

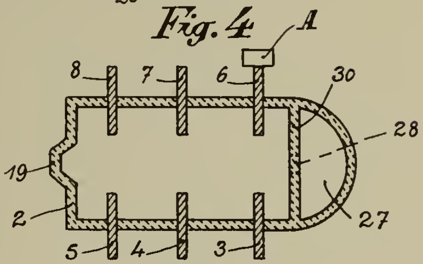


Fig. 5

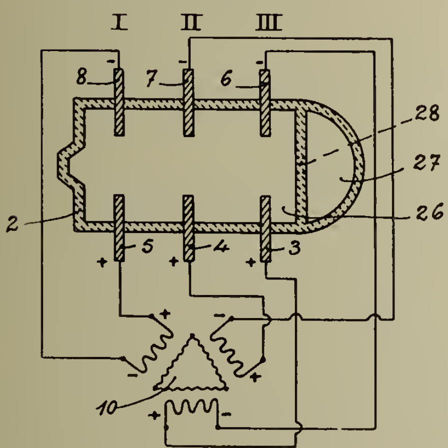


Fig. 6

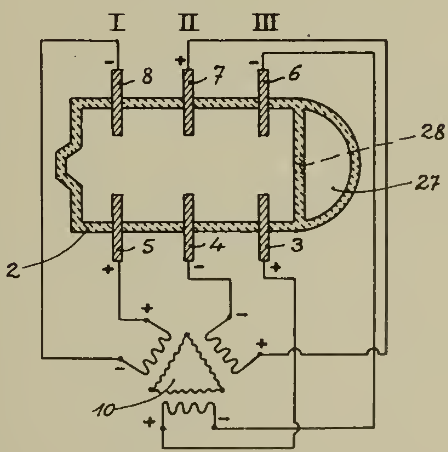


Fig. 8

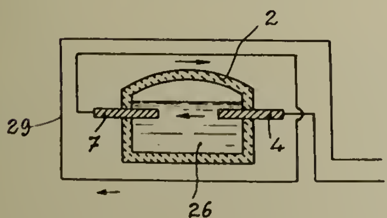
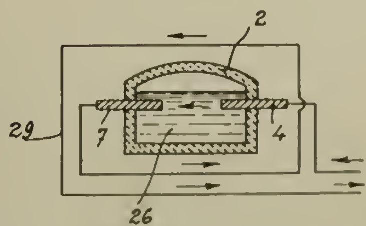


Fig. 7



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Serial No. 440,418

ALIEN PROPERTY CUSTODIAN

APPARATUS FOR COPYING DOCUMENTS AND THE LIKE

René Alphonse Higonnet and Louis N. Chereau, Lyon, France; vested in the Alien Property Custodian

Application filed April 24, 1942

This invention relates to an apparatus for the reproduction of documents, particularly for the taking of photographs on a continuous strip, and more especially to a device that makes it possible to photograph on a film pages of texts or figures or other objects. More especially, on a standard 35 mm film it is possible to photograph two pages of text each having a size of 18 x 24 corresponding to the standard picture of the silent screen.

The use of standard film makes it possible to utilize the facilities provided by the film industry, more especially those of developing and making reproductions or copies.

According to certain features of the invention, control of the exposure time is effected by purely electric improved means; these means permit variation of the exposure time by the mere manipulation of a knob. A relay circuit is provided for the purpose of preventing double exposures.

According to one embodiment, the camera does not contain any mechanical shutter, the mechanical control of which might cause a slight vibration that would injuriously affect the sharpness of the picture. The tubes are lighted to dark red in the usual way and are automatically stepped up in voltage for the photographing. According to other features of the invention, use is made of an electrically controlled shutter. For the filing of the films it is advisable to divide them into strips, e. g. of 6 pictures, 5 being reserved for the text, i. e. for 10 pages, and one picture being reserved for a reference that can be photographed on the film in large letters visible to the naked eye as soon as the pictures have been taken.

In order to permit the operator to do this work, there is provided a metering circuit which gives a signal after the 5th picture, thus warning the operator that he must reserve the following shot for photograph of the reference of the following series. This metering relay consists, for example, of a chain of relays which look successively after each picture and finally actuate a relay that cuts off the lighting circuit of the tubes or else actuates a relay or some other device so as to warn the operator. Other metering systems may also be used.

The invention is explained hereunder in the description of embodiment examples given with reference to the appended drawings, in which:

Fig. 1 is a schematic view in perspective of a camera for photographing on microfilms, according to the invention.

Fig. 2 is a diagram of the automatic electric control of the exposure time and of the metering system, according to the features of the invention.

Referring to Fig. 1, the advance of the film is effected by means of a claw control, by turning the knob **1**.

This knob carries a cam **2** provided with a ramp, and attached to the cam by means of a spring there is a finger **3** which can enter a sloping eyehole **4**.

Turning of the knob in clockwise direction first releases the presser **5** which holds the film in place by means of a plate and springs **8***a*. Then the finger **3** abuts against the bottom of the eyehole **4** and actuates the feeder reel **7** which in its turn draws along the film; after advancing by one frame, the finger abuts against the support **6**. By then turning anti-clockwise, the finger **3** comes out of action owing to the slope of the eyehole **4** and the reel **7** remains stationary. At the end of its path of travel, the fingers **3** drops into the eyehole **4** bis, which is symmetrical with the eyehole **4** with respect to the center of the cheek of reel **7**, and the presser is pushed by the ramp of cam **2**; by tilting the presser, the contact **8** has thus been closed at that moment and the apparatus is ready to operate for another picture. For this it is sufficient to press down the button **9**.

The current feed (network) is connected to the terminals B**1** from where the current actuates a synchronous motor MS, which serves for furnishing well determined illumination times, and also feeds the tubes L across the resistance R. It is by short circuiting this resistance that the intense luminous flux that permits the photographing is obtained. The rectifier RD, which has one outlet terminal (−) grounded, is fed by means of the transformer T**3**. The camera's commutator **8** has also one terminal grounded. Depression of the button **9** actuates relay R**1** which closes contact C**1** and this contact will remain blocked as long as contact **8** is closed. There are two cases to be considered:

1st case.—Upon depressing the button **9**, the cams *Ca* are in such a position that the circuit B**2**, B**3** is closed by means of *Ca*. If it is desired to have the exposure time that has been determined upon, the apparatus will have to wait until *Ca* passes again before operating. This is obtained in the following way: Depression of the button **9** actuates relay R**2** which closes contact C**3** and opens C**2**.

If the circuit *b*2, *b*3 is closed by *Ca*, relay R**2** will be blocked, because the current will pass through R**2** and C**3** to close again over ground.

C2 will accordingly remain open and the mercury contact C*m* will be isolated. As soon as the motor has rotated by an angle sufficient for breaking the contact C*a*, relay R2 will cease operating and, as soon as contact C*a* is made again, the current will pass through R5 on to the battery which it will actuate and cause the tilting of the mercury switch C*m* which will short circuit the resistance R and step up the voltage of the tubes L, thus making it possible to photograph. This will continue as long as C*a* closes the circuit, i. e. during a predetermined angle of rotation of the motor.

2nd case.—Depression of the button 9 places the cams C*a* in such a position that the circuit *b*2, C*a*, *b*3 is open.

In this case, relay R2 ceases to operate as soon as the button 9 is released. As soon as the cams C*a* establish the contact, the circuit will be closed by passing across relay R3 which actuates the mercury switch, and the voltage of the tubes L will be stepped up, as explained above.

The device described hereunder prevents double exposures.

Relay R3 which controls the mercury switch can not operate when contact C4 is open except when contact C6 is closed; as soon as cams C*a* permit passage of the current, relay R3 operates and closes contact C4 as well as contact C5. Since contact C5 is closed, relay R4 will operate in its turn and will open contact C6 and close contact C7. Since, by passing over the contact C7, the current can then directly reach the positive pole of the battery, relay R4 will be blocked as long as the circuit M2, C9, C7 is closed, i. e. as long as contact 8 is closed. Relay R3, which operates as long as the cams C*a* allow current to pass, will return to rest as soon as these cams permit no more current to pass, i. e. when the exposure has been made.

If, after the exposure, the button 9 is again depressed without having broken the contact 8, i. e. without having advanced the film, relay R3 will not be able to operate, because the circuit can not close again either over contact C4, which is in the resting position and consequently open, or over contact C6 which is actuated by relay R4 which is blocked, as explained above. It will therefore be absolutely necessary to advance the film before being able to take another photograph.

The operation of the metering device is as described hereunder. The circuit closes over the ground M1 after having passed through contact C8, relay R6 which controls contact C10, commutator I_1, and contact C6. Relay R7 is then branched on two + and does not operate. As already explained above, the photographing is done when the mercury switch C*m* tilts upon being actuated by relay R3. This relay likewise closes contact C4 and contact C5. As soon as contact C5 closes, the current passes through relay R4 which it actuates. This relay R4 opens contact C6 and closes contact C7. From this moment, relay R4 will be blocked as long as switch 8 remains closed, because the circuit M2, 8, C9, R4, C7 will be closed; the operation of relays R3 and R4 has not affected the metering circuit except in that the current is closed over C4 instead of being closed over C6. The current will accordingly pass through relay R6, commutator I_1 and contact C4 as long as the photographing continues, i. e. as long as relay R3 is actuated.

As soon as the photographing is completed, contact C4 will be broken owing to relay R3 being no longer actuated and, since the current proceeding from relay R6 can no longer reach the positive pole over commutator I_1 and contact C4, it will have to reach the positive pole through relay R7 and contact C10, which is closed as explained above.

Operation of relay R7 causes operation of commutator I_1 which immediately places commutator I_2 in communication with contact C4.

According to certain features of the invention, contact 8 is automatically broken as soon as the film is advanced by one frame, and this will cause relay R4 to fall back to its resting position and will reestablish contact C6. At this moment, relay R8 will operate as described above for relay R6 and, also as indicated above, contact C4 will be made and contact C6 will be broken at the start of the second photographing and, when the second photograph is taken, i. e. as soon as contact C4 is broken, commutator I_2 will operate in the manner described for commutator I_1, and so on until the 6th photograph is taken.

When the knob is turned to advance the film by one frame before the 6th picture, relay R18 will be actuated in the manner described above for relay R8, and contact C16 will be closed.

After the 6th picture has been taken, relay R17 and commutator I6 will operate in the same manner as indicated for relay R7 and commutator I_1. As soon as the film is again advanced by one frame, i. e. before the 7th picture is taken, relay R4 will return to rest in the already explained manner and contact C6 will be made. The current proceeding from M3 will pass through the alarm A, which may be any instrument or device actuated by the electric current, and will reach the positive by passing over the commutators I_5, I_4, I_3, I_2, I_1 and contact C6. The current will thus close over the ground M2, passing through relay R16 which it will actuate. This relay will close contact C15 and will be blocked until button 10 is depressed. When relay R16 comes into operation, it opens contacts C8, which will bring back the metering device to zero, and contact C9 which will make it impossible to take any new pictures until the button 10 has been depressed and relay R16 has thus been brought back to the resting position.

The operator's attention is thus positively called and he will know that the next picture must be reserved for the reference legibile to the naked eye which is to characterize the subsequent strip of 6 pictures.

Relay R5 can actuate a general totalizing meter Co which operates in the following manner.

When the contact 8 is closed, the circuit M2, 8, C9, R5, C6, is closed and relay R5 comes into operation. As soon as contacts C4 and C6 open, i. e. upon taking a picture, the circuit is opened and relay R5 ceases to operate. On returning to its resting position it has advanced the meter Co by one tooth, i. e. by one unit, and since this mechanism repeats every time that the mercury switch tilts, the total number of pictures taken will be registered on the meter Co.

It is evident that the metering system employed may be different from the one that has just been described as an example. In particular, use may be made of devices such as step by step selectors of the kind used in automatic telephony. These instruments may be disposed so as to advance by one step after each picture and give a signal at the end of each series of 5 pictures.

According to certain features of the invention,

the terminals $b4$, $b5$, $b6$, $b7$ make it possible to use the automatic control circuit of the mercury switch for other purposes.

By opening C11 it is possible to branch between $b4$ and $b5$ any device that has to be stepped up in voltage for a definite time. In this case, use is made of the resistance R, this resistance being cut out of circuit by manipulating the commutator 17. It is then possible to branch between the terminals $b6$ and $b7$ any device that has to receive an electric current at a given moment for a definite time.

More particularly, it is possible to branch between these terminals an enlarging system that comprises a means for automatic advance; this will permit the making of enlargements of a film at as rapid a speed as the photographing, i. e. 500 to 600 pages per hour, for example.

The camera may also be used for this purpose by placing a lamp and an optical system in a suitable position within it.

When it is a question of reproducing a large number of documents it is thus possible to attain a speed considerably greater than that of other devices, although having to use a negative, and there is the further advantage of having the final document in the form of a positive.

In particular, the operation of the apparatus may be made entirely automatic, e. g. by operating the film's advance device by an electrically controlled plunger or motor mechanism. The control of the manipulating button may be combined with the device for holding the two pages of a book in one plane. If this device comprises a sheet of glass applied against the volume, it will be sufficient to have its switch controlled.

If it is desired to avoid the fatigue resulting from the succession of flashes, use may be made of a shutter, as provided. According to certain features of the present invention, this may consist of a movement of the kind used in movable frame measuring instruments, the frame carrying an extremely light aluminum vane that blocks the luminous beam.

Transmission of a current causes the frame to turn and the vane moves aside, permitting the exposure. This device prevents all vibration, since the vane reaches its shifted position without vibration and without striking against any stop.

Although the present invention has been described in connection with examples of embodiment, it is evident that it is by no means limited to the said examples and that the same are capable of numerous variations and modifications without departing from the scope of the invention.

Summary

The present invention relates to photographic reproduction apparatuses and in particular to apparatuses that use moving picture film and have automatic electric control devices that prevent double exposures, and that give the operator a signal for each series of 10 pages photographed, e. g. to warn him to insert a reference that serves for the later filing of the films per series of 10 pages in special index files.

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RENÉ HIGONNET.

PUBLISHED — R. A. HIGONNET ET AL — Serial No.

JUNE 1, 1943. — APPARATUS FOR COPYING DOCUMENTS AND THE LIKE — 440,418

BY A. P. C. — Filed April 24, 1942 — 2 Sheets-Sheet 1

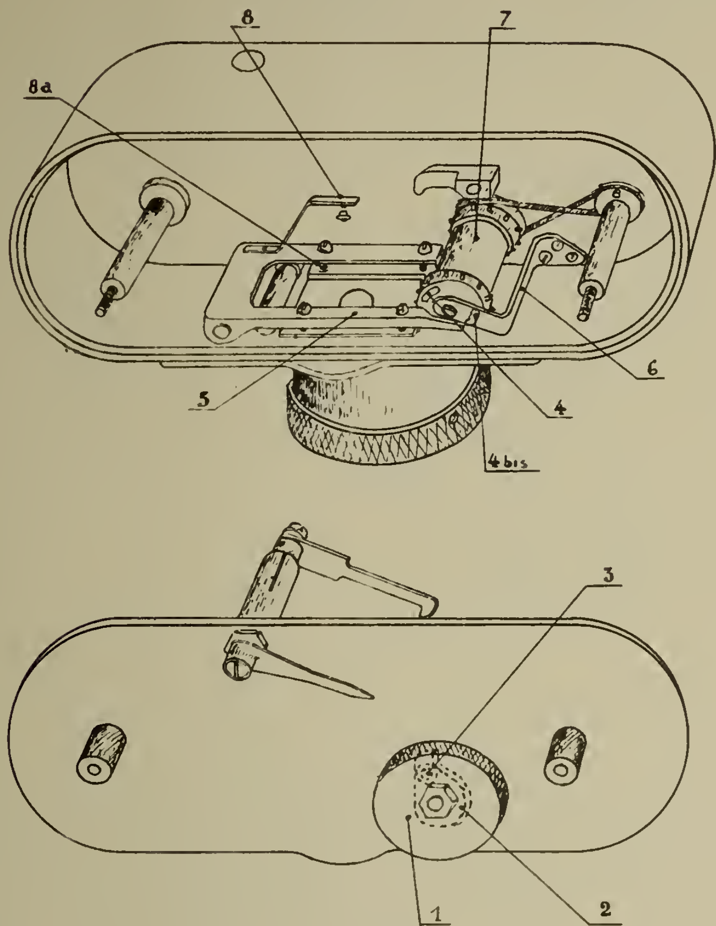

Fig. 1

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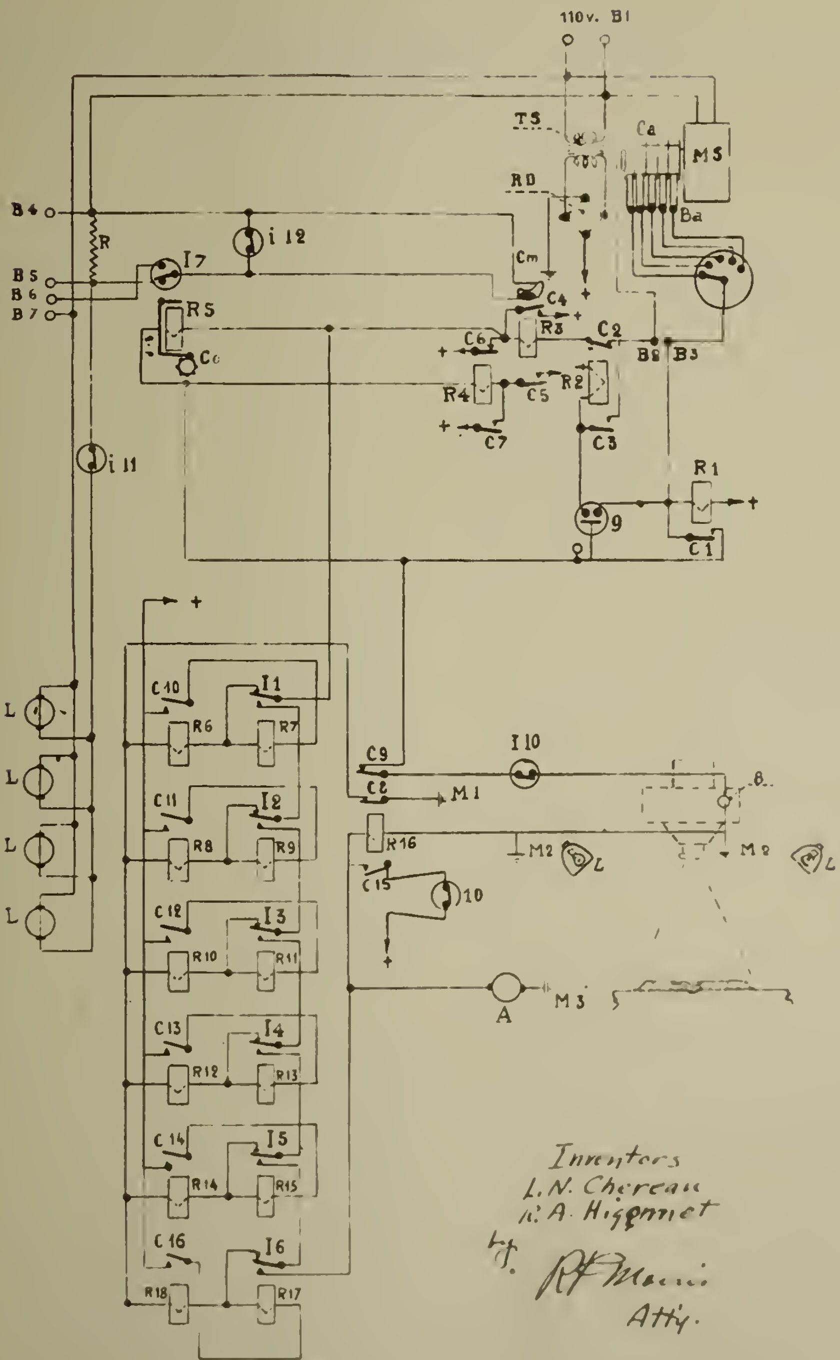
Fig. 2



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Published June 1, 1943

Serial No. 440,865

ALIEN PROPERTY CUSTODIAN

DEADCENTRELESS CRANK GEARS

Georges Marquet, Lyon, France; vested in the Alien Property Custodian

Application filed April 28, 1942

The present invention relates to crank gears of the kind adapted to be used on cycles, pedal machines, piston engines and like machines, and it has reference more particularly to improvements in the construction and operation of such gears.

The usual crank gears hitherto employed for these purposes are, generally, formed with two crank arms which are placed at 180° and fixed to the ends of a shaft common to both them. The said arms are acted upon by pedals or driving rods for converting reverse and uplift motion, or reciprocating rectilinear motion into rotatory motion of a driving wheel, or vice versa, which wheel is concentric with and fast on said shaft. Such crank gears are liable to the inconvenience of impeding the transmission of torques in the dead centre positions of the crank arms, because in these positions the power imparted for instance to the cranks by the pedals or driving rods is effective in a plane intersecting the axis of the crank shaft.

It is an object of the invention to introduce a more efficient method of converting reciprocating rectilinear motion into rotatory motion, and vice versa, by employing crank gears exempt from dead centres.

A further object is to provide a crank gear of this nature which will operate continually by producing torques that are effective throughout the entire crank path, and whereby transmission of power is rendered more uniform.

A still further object is to provide a crank gear of improved construction having relatively few and simple parts which are inexpensive to manufacture and install and which are durable, reliable and efficient in use.

With the aforesaid and other objects in view which will appear as the description proceeds, the invention comprises the combination of at least two separate coaxial cranks normally placed at 180° for alternately taking up a driving and a driven position upon rotation about the axis of the crank gear, said cranks being mounted for relative rocking movement about the said axis so as to be capable of turning at different speeds with respect to each other in the operative direction of rotation, and a rotatable driving organ eccentrically disposed with respect to the axis of the crank gear, said organ having an articulated driving connection with each of said cranks and being operative to alternately turn the inoperative crank past one dead centre position into a driving position before in the other dead centre position the operative crank changes from the driving state into the driven state.

In order that the said invention may be clearly understood and readily carried into effect, the same is described more fully with reference to the accompanying drawings which illustrate several embodiments by way of example.

In these drawings:

Figs. 1*a* to 1*c* are diagrammatic views showing a first embodiment of the invention in different working positions.

Figs. 2*a* to 2*c* are similar views showing a second embodiment of the invention in different working positions.

Figs. 3 and 4 show the second embodiment as applied to a cycle drive; Fig. 3 is an axial sectional view through the parts shown in Fig. 4 on the section line S—S appearing therein, and Fig. 4 is a side elevation looking in from the right of Fig. 3, the crank arms for the sake of clearness being omitted.

Figs. 5 to 8 show the second embodiment as applied to a double-throw piston engine. Fig. 5 is an axial section through the crank gear of said engine, and Fig. 6 is a cross section taken on the line T—T in Fig. 5. Figs. 7 and 8 illustrate, respectively, by a fragmentary axial sectional view and a side view the mode of operation of said crank gear.

Figs. 9 and 10 are similar views showing the first embodiment of the invention as applied to a four-throw piston engine.

In the embodiment shown in Figs. 1*a* to 1*c*, *a* represents a driving wheel having its centre at A and being eccentrically disposed with respect to the axis of a crank shaft B. The said wheel is shown provided with guide slots a_1 and a_2 engaging, respectively, pins c_1 and c_2 which are slidable in said slots and fixed to the ends of crank arms b_1 and b_2 mounted for relative rocking movement about the axis of the crank shaft B. Upon turning of the crank B, b_1, b_2, for instance in clockwise direction, the driving wheel *a* is set in rotation, whereby in the vertical position of the guide slots a_1, a_2, the crank arms b_1, b_2 branch at an acute angle from the axis of the shaft B (Fig. 1*a*), while in the horizontal position of the guides, said crank arms are brought into alignment with each other and coinciding with the centre line A—B (Fig. 1*c*). It will be appreciated, therefore, that each complete revolution of the driving wheel *a* causes the crank arms to rotate with different speeds so as to enable the rising crank pin c_1 to move past the upper dead centre position before the de-

scending crank pin c_3 reaches the lower dead centre position (Fig. 1*b*).

In the embodiment shown in Figs. 2*a* to 2*c*, the crank shaft B′ is shown carrying two crank arms b'_1 and b'_2 mounted for relative rocking movement about the axis of said shaft and coupled by means of links d_1 and d_2 to a driving wheel *a′* having its centre at A′. The operation of this crank gear is the same as has been described relative to Figs. 1*a* to 1*c*, with the difference however, that the aligned crank arms do not coincide with the centre line A′ B′ but are set at the same angle therewith as the diameter of the wheel *a′* connecting the pins c'_1 and c'_2.

In the construction according to Figs. 3 and 4, showing the crank gear of Figs. 2*a* to 2*b* as applied to a cycle drive, **1** generally indicates a crank shaft one end of which is received in the bearing **2** of a gear casing **3**. Fixed to or forming parts of the said shaft are a crank arm **4** and a lever **5**. The shaft **1** is internally drilled longitudinally from one end to a predetermined point for rotatably bearing a second crank shaft **6** which is coaxial with the first shaft and upon which are rigidly secured or formed a lever **7** and a crank arm **8**, the latter being normally set 180° with the crank arm **4**.

The levers **5** and **7** are articulated by means of links **9** with a driving organ **10** which is eccentrically arranged with respect to the axis of the crank shafts **1** and **6**. In the example shown, the said organ is rotatably supported on an outer eccentric bearing surface **11** provided by a boss **12** fixed to the gear casing **3**, and it is formed with radial members **13** terminating in eyes **14** by means of which it may be suitably attached to the chain wheel, not shown, of a cycle. The driving organ might also be made a part of the chain wheel but, for convenience of manufacture, is preferably made separate therefrom. The boss **12** is herein shown providing at the same time a bearing for the other end of the crank shaft **1**. The eccentricity of the outer bearing surface **11** of said boss has, in the present instance, a predetermined value; yet if desired, it may be adjustable by any convenient means not shown. To the outer ends of the crank arms **4** and **8** may be pivoted the pedals of the cycle not represented in the drawing.

The operation of this crank gear is the following: By moving the pedals up and down as may be the case on an ordinary cycle, the crank arms **4** and **8** are rotated together with their shafts **1** and **6** about the axis thereof, and such rotation is transmitted by the levers **5** and **7** and the links **9** upon the eccentric driving organ **10**. As clearly shown in Figs. 1*a* to 1*c* and 2*a* to 2*c*, each complete revolution of said organ causes crank arms **4** and **8** to undergo a relative angular displacement with respect to each other, the rising or driven arm **4** being turned quicker than the descending or driving arm **8** so as to lead the inverted position of the same by a certain angle which depends upon the eccentricity of the organ **10**. When, on the one hand, the rising arm coincides with the vertical plane intersecting the axis of shafts **1** and **6**, the descending arm has not yet reached said plane and is therefore still in driving relation while, on the other hand, upon coinciding of the descending arm with said plane, the rising arm has already been advanced over said angle into the driving position. Owing to this alternate overriding or leading of the effective driving actions of the arms **4** and **8** the crank is automatically moved past it dead centre positions without interrupting the production of torques. The latter are effective throughout the entire crank path and, consequently, transmission of power is rendered more uniform, and the efficiency of the crank gear is greatly increased.

In the construction according to Figs. 5 to 8, showing the crank gear of Figs. 2*a* to 2*b* as applied to a double-throw piston engine, **20** indicates an internally drilled crank shaft rotatable in bearings **21** and **22** formed in the machine casing **23**. Within the shaft **20** is rotatably supported one end of a second crank shaft **24** which is coaxial with said first shaft and having its other end received in a bearing **25** of the machine casing. The shaft **20** carries a crank **26** and a lever **27** fast therewith, and the shaft **24** is shown formed with a crank **28** which is normally placed at 180° with the crank **26**. Lever **27** and crank **28** are each articulated by means of a link **29** to a toothed wheel **30** arranged eccentrically with respect to the axis of rotation of the shafts **20** and **24** and freely revoluble about the said axis. In the present instance, said wheel is rotatably supported on an outer eccentric bearing surface **31** of the bearing body **22** and it engages with a gear wheel **33** fixed to a transmission driving shaft **32**.

The further construction and the mode of operation of this engine drive is clearly shown in Figs. 7 and 8. To each of the cranks **26** and **28** is articulated a connecting or driving rod **34** acted upon by a piston **36** reciprocating in a cylinder **35** of the engine. In the example shown, the pistons **36** are leading or lagging each other by 180° in the cycle of action, and their reciprocating movement is imparted by the said connecting rods upon the cranks **26**, **28** which, by reason of their mounting on different crank shafts, are rockable against each other about the axis of said shafts. From the cranks rotation is transmitted by the intermediary of the links **29** upon the toothed wheel **30** which drives the gear wheel **33** on the transmission shaft **32**.

Owing to the eccentric mounting of the wheel **30** with respect to the crank shafts, the cranks **26** and **28** will alternately lead the aligned position in which they are normally coinciding and change over from an inoperative to an operative state without having to overcome dead centres. Accordingly, also the pistons **36** will overtake each other in the cycle of action; when the driving piston, i. e. the piston shown on the right of Fig. 8, reaches the outer end position wherein it reverses from the operative to an inoperative state, the other or driven piston shown on the left of said figure has already left the inner end position and retaken its operative stroke. It will be appreciated, therefore, that the operative stroke of each of the pistons shown always commences before the end of the operative stroke of the other or complementary piston.

Figs. 9 and 10 show a four-throw piston engine embodying a crank gear according to Figs. 1*a* to 1*c*. The said gear comprises again two coaxial crank shafts **40** and **41** rotatably mounted one within the other. The outer or hollow shaft **40** has fast thereto a crank **42** and a lever **44**, and the inner shaft **41** is shown formed with a crank **43** and a lever **45**. The free end of each of said levers carries a pin **46** and **47**, respectively, which are slidable in slots **48** and **49** provided in a toothed wheel **50** which is eccentrically disposed and freely revoluble about the crank shafts. The cranks are normally placed at 180° and each of them is jointed to a pair of piston rods **52**, **52′**.

and **53**, **53'**, respectively. Also in this engine drive it will be seen that, owing to the eccentric mounting of the driving wheel **50**, the pistons acting upon different cranks will alternately overtake each other in the cycle of action, thereby ensuring a perfect uniform running of the engine at an increased efficiency.

The improved crank gears represented in Figs. 5 to 10 may be substituted for the intermittent or jerky drives hitherto employed on piston engines and the like. Moreover, the crank gears according to the invention are particularly adapted for use in continuous acting gear drives producing variable speeds by means of an adjustable fluid volume. The piston engine is then intended to operate as hydraulic motor for driving by means of the cranks shown, a revoluble organ which is eccentrically disposed with respect to the axis of the crank gear and adapted to impart uniform rotation at variable speeds to a machine tool or the like.

From the foregoing, it is believed that the construction and advantages of the present invention may be readily understood by those skilled in the art without further description, it being born in mind that numerous changes may be made in the details disclosed without departing from the spirit of the invention. It will be seen, in particular, that the independent mounting of the cranks for relative rocking movement, as well as the jointed connection between said cranks and the eccentric driving organ may be realized in other ways different from the examples shown. Moreover, there might be provided more than two coaxial crank shafts for rotating about an axis common to all them, and each shaft might be formed with several cranks placed at suitable angles from each other.

GEORGES MARQUET.

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JUNE 1, 1943.
BY A. P. C.

G. MARQUET
DEADCENTRELESS CRANK GEARS
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3 Sheets-Sheet 1

Fig. 1a.

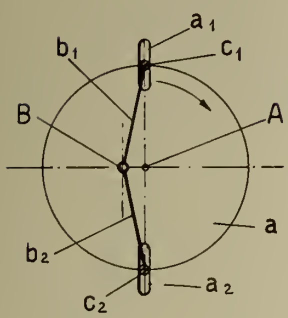


Fig. 1b.

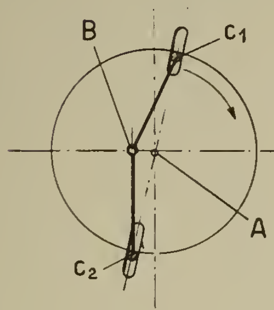


Fig. 1c.

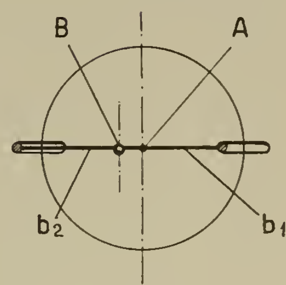


Fig. 2a.

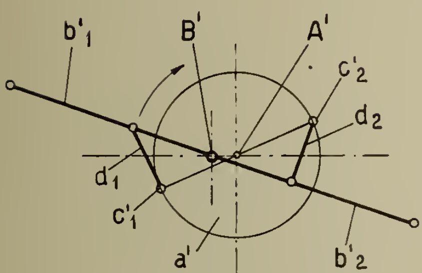


Fig. 2b.

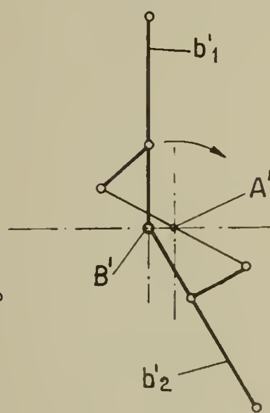


Fig. 2c.

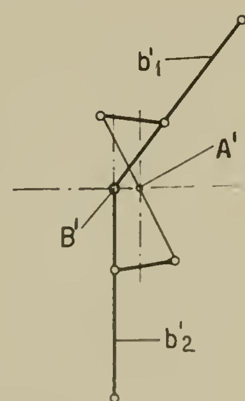
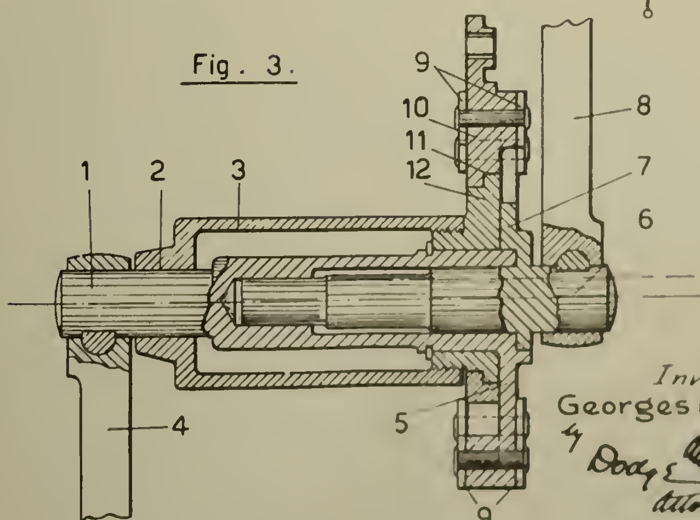


Fig. 3.



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BY A. P. C.

G. MARQUET
DEADCENTRELESS CRANK GEARS
Filed April 28, 1942

Serial No.
440,865
3 Sheets-Sheet 2

Fig. 4.

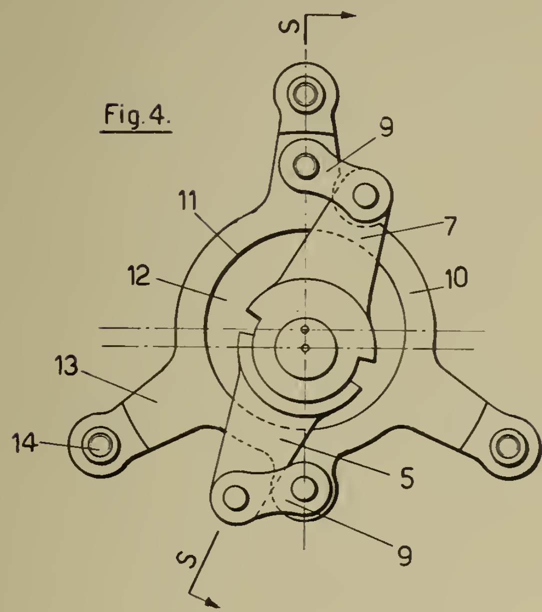


Fig. 5.

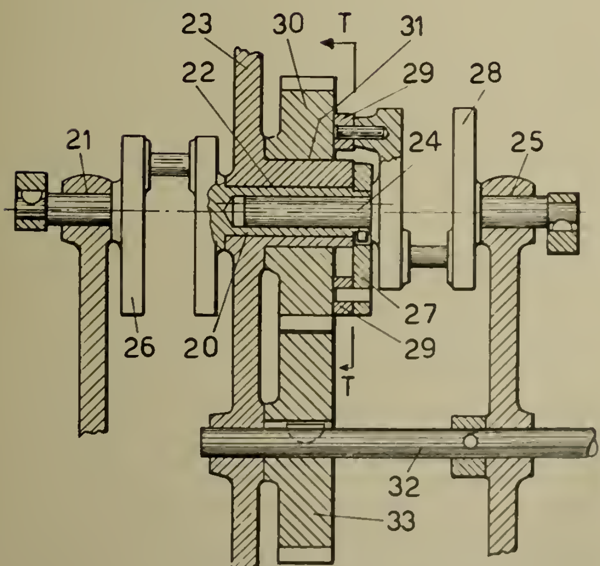
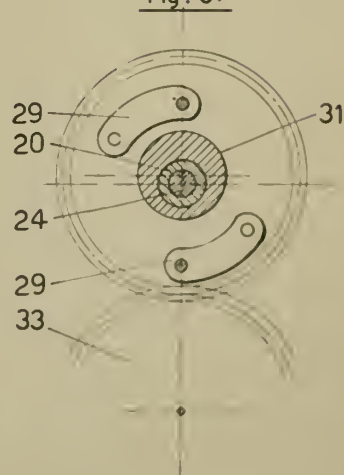


Fig. 6.



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3 Sheets-Sheet 3

Fig. 8.

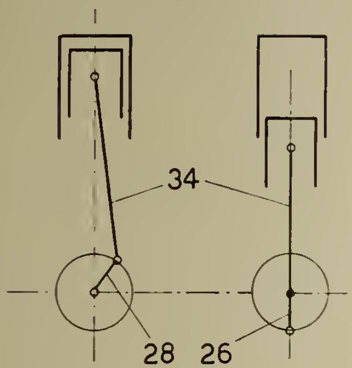


Fig. 7.

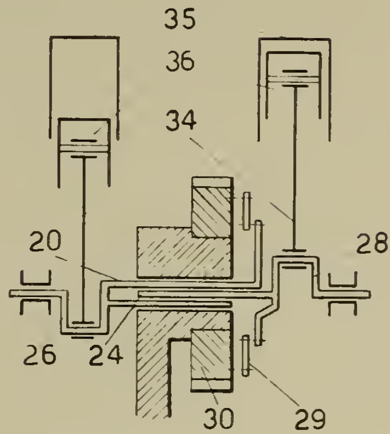


Fig. 10.

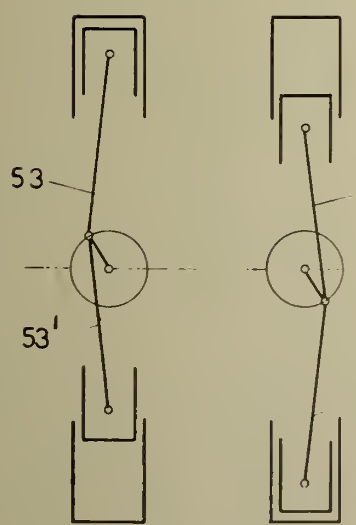
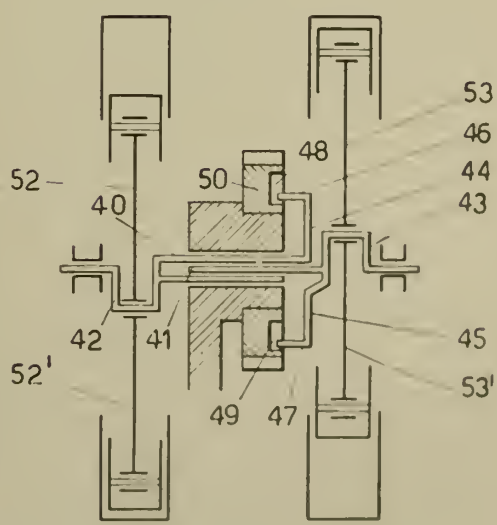


Fig. 9.



Inventor
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Attorneys

Published June 1, 1943

Serial No. 446,074

ALIEN PROPERTY CUSTODIAN

METHOD OF MAKING FUR-LIKE ARTICLES

Emmanuel Prosper Marie Bechetoille, Lyon, France; vested in the Alien Property Custodian

Application filed June 6, 1942

The manufacture of miscellaneous fancy articles or fabrics such as fur-like articles and particularly of artifical furs similar to astrakan has been performed heretofore either by an embroidery process on looms of different types or by a weaving process or else by processes involving the application of pile stuff to some suitable form of carrying foundation.

An object of the present invention is to provide an improved method belonging to the so-called application type and making it possible to manufacture the aforesaid kind of fancy articles in a cheaper, quicker and easier way than with prior processes.

Another object of the invention is to provide a method for manufacturing fancy fur-like articles or fabrics by improved means permitting various fancy effects to be obtained by more or less densely crowding up successive batches or tufts of pile stuff upon and along a supporting surface provided with staples or teeth to which said stuff is progressively clung into position.

A further object of the invention is to provide a method of manufacturing fur-like articles by improved manually adjustable manipulations permitting a substantially perfect imitation of the pile or hair waves and windings of natural furs to be obtained.

A still further object of the invention is to provide a method of manufacturing fur-like articles in various fancy aspects permitting the symmetrical transfer on frames as in some prior mechanical processes as well as the concomitant disadvantages to be obviated.

With these and such other objects in view as will incidentally appear hereafter, the invention comprises the novel steps and sequences of steps that will now be described with reference to the accompanying diagrammatic drawing showing an embodiment of the invention and forming a part of the present disclosures.

In the drawing:

Figure 1 is an elevational view partly in section showing the first step of the improved method.

Figure 2 is a view similar to Fig. 1 showing the second step of the improved method.

Figure 3 is a view similar to Fig. 2 showing the third step of the improved method, assuming the carrier to which the tufts of the crowded pile stuff adhere to be stripped off the staples of the card-like surface by being rolled up as shown by the arrow.

Figure 4 is a top plan view corresponding substantially to Fig. 3 and showing the guiding pattern.

Like reference characters designate like parts throughout the several views.

As illustrated, the card-like surface comprises teeth or staples *a* all inclined upwardly in the same direction and set into a suitable foundation *f*. Along the staples *a* and in the direction shown by the arrow *x* (Fig. 1) in which they slant up is slid slantwise in rubbing relation to their tips a sequence of tufts b^1 of a fibrous material such as a pile, hairy or nap stuff which may be for example the stuff known in the textile trade as "chenille." The rubbing of each batch or tuft b^1 of this material is so performed manually or mechanically as to gradually tamp the successive tufts against previously set tufts such as *b*, thereby tamping or crowding them up together while causing them to securely cling to the staples *a* so that once clung in his way the tufts *b* can no longer move back or forth. The pressure exerted on each batch or tuft b^1 to tamp it against the preceding batches may vary from any batch to another batch for varying the effects and enabling various fancy patterns to be achieved, thereby causing the article when completed to have closely or finely set pile and to more or less resemble natural furs such for example as true astrakan.

Once a layer or lap of contiguously tamped tufts *b* is obtained as shown on the right hand side of Fig. 1, the method includes the further step of applying a carrier such as *c* having a tacky, glued or other adhesive surface *d* into sticking contact and engagement with said layer or lap which then still firmly clings to the staples *a*, as shown in Fig. 2.

The next step consists in gradually removing the carrier *c* to which the tufts *b* then adhere from the staples *a* by a stripping or disengaging motion capable of gently breaking off the clinging action. This disengaging motion may be either a translatory motion of the carrier unit *c*—*d* in the direction shown by the arrow *x* in Fig. 1 or an angular or rotary motion substantially as depicted by the arrow *y* in Fig. 3 or even a succession or combination of these two motions so as to dislodge each tuft *b* from the row of staples *a* to which it has been clinging without curtailing its adherence to its carrier *c*.

The adhesive material such as *d* a film of which coats the carrier *c* may advantageously contain rubber or a rubber-holding composition. In this case, the method may include as a final step a curing operation such as a cold chemical vulcanization adapted to firmly unite the carrier and its tuft covering.

On completion of the operation, the chenille or other fibrous tufts thus stuck upon the carrier *c* keep the particular positions which were imparted to them as they were tamped and clung to the staples *a*. The particular fashion in which the pile tufts were cluster to imitate natural furs is thus preserved.

In order to assist in the arrangement of the tufts *b* on the staples *a*, the foundation *f* may be provided with any suitable pattern such as the one diagrammatically shown at *p* in Fig. 4. This pattern may be engraved, drawn, painted, stencilled or otherwise produced on the face of the foundation *f* which shows across the staples *a* projecting therefrom so as to assist the operator in the arrangement of the tufts b^1 into a cluster *b*.

If required, the method according to the invention may be followed by such additional steps as a trimming operation and/or a rolling or a calendering operation through a mangle or like contrivance so as to render the adhesion of the tufts *b* to the carrier *c* more uniform throughout the area of the latter.

It will be understood that the improved method applies to all hairy, feathery or downy materials such as pile or nap stuffs. All these are intended to be included in the scope of the general expression "fibrous material" used for the sake of convenience in the subjoined claims.

EMMANUEL PROSPER MARIE BECHETOILLE.

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BY A. P. C.

E. P. M. BECHETOILLE

METHOD OF MAKING FUR-LIKE ARTICLES

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Fig. 1

Fig. 2

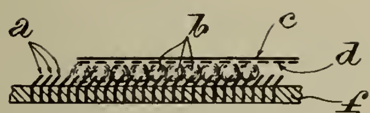


Fig 3

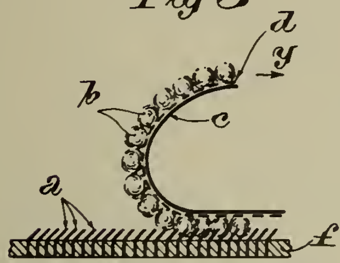
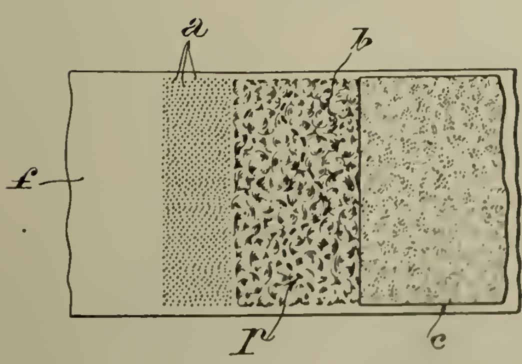


Fig. 4



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ALIEN PROPERTY CUSTODIAN

FASTENING DEVICES

Fritz von Opel, Miami, Fla.; vested in the Alien Property Custodian

Application filed June 18, 1942

This invention relates to fastening devices, in particular removable fasteners, to join two or more objects which are substantially flat at the joint, such as e. g. plates or sheets of metal, laminated material, and the like, through substantially registering holes in them of equal or different sizes.

In particular the invention relates to removable fastenings for connecting a cover of any suitable shape with another object, such as a cowling with the rim of a man hole or filling-in orifice of another hollow body, such as e. g. a part of the wing or fuselage of an aircraft or the body of a vehicle.

More specifically the invention is concerned with removable fastenings for joining in a lap-joint two or more flat objects, such as e. g. plates or sheets of metal, such as aluminum or an aluminum alloy, laminated plastic material, and the like, which are accessible only from one side.

This application also forms a continuation in part of my copending patent application Serial No. 431,625, filed Feb. 20, 1942. In this my copending application I suggested a fastener comprised of a shank and head, the latter provided with a kerf or other means for turning the fastener, and a dish-like member through which the shank of the fastener, is passed. The dish-like member is mounted in a hole of one of the bodies to be connected with another one, e. g. by soldering, welding, spot welding, riveting or the like the rim of a flange of the dish to the edge of the hole. The center portion of the dish-like member is provided with a center hole and radially cut in to form somewhat springy flaps which engage a circular groove on the shank of the fastener when it is pressed into the center hole whereby the fastener is held in place.

It has been suggested previously to provide the shank of fasteners of this type with two bayonet slots opposite one another, and to arrange a springy member across the hole in the plate which is to be fastened to another one so that the springy member engages the bayonet slots and is fixed therein upon turning the shank. This necessitated a relatively long shank of the fastener, and machining of the bayonet slots required considerable and accurate work. It has also been suggested to arrange a broad arcuated spring member across the hole in the plate which is to be fastened to another one, to rivet the ends of that member to that plate and to provide that member with a great number of slots and bent portions in order to permit riveting of it to the plate and passing the shank of the fastener and projections connected therewith through the member; after the shank has been passed through the slots, it was to be turned until its projections entered depressions in that springy member.

It is an object of the invention to simplify the manufacture of the elements of fastening devices of such type and their mounting.

It is another object of the invention to use more simple shapes for the elements of the fastening device which can be easily produced in inexpensive mass production and mounted in holes of regular, such as circular shape, without deforming the rims of the holes.

It is a particular object of the invention to use a pair of wire-like springy connecting members arranged across the hole through which the shank of the fastener is to be passed, and which engage the recessed and/or flattened shank from opposite sides so as to hold it in place when inserted and until it is turned into a blocking or fixing position.

It is a specific object of the invention to use a pair of wire-like springy connecting members arranged across the hole through which the shank of the fastener is to be passed so that these members are elastically deformed when a recessed and/or flattened shank portion is introduced between them and thereby hold the shank in place, and are preferably still more elastically deformed when or while the shank is forcibly turned by a predetermined angle into a blocking position in which said members engage a recessed portion of the shank.

These and other objects of the invention will be more clearly understood when the specification proceeds with reference to the drawings in which sveral features of the invention are exemplified.

In particular, Fig. 1 shows a cross section with parts in elevation through two sheets or plates connected by a fastener and springy connecting member according to the invention, with a fastener just being inserted; Fig. 2 a similar cross section as Fig. 1 with the fastener being turned by about 90° into its locking position; Fig. 3 a view along line **3—3** in Fig. 1; Fig. 4 a top view upon the two plates and the fastener in its locking position according to Fig. 2; Fig. 5 a top view and Fig. 6 a side view of the springy connecting member; Fig. 7 a cross section with parts in elevation of a modification of the invention with a fastener in its locking position; Fig. 8 a view from below of a dish-like member used in Fig. 7; Fig. 9 a cross section with parts in elevation of another modification of the invention; Fig. 10 a top view of that modification with the fastener in locking

position; Fig. 11 a similar top view with the fastener inserted and being turned toward its locking position; Figs. 12 and 12*a* in elevation a fastener as used in the modification of the invention according to Fig. 9; Fig. 13 a side view and Fig. 14 a top view of the fastener; Fig. 15 a cross section along line **15—15** in Fig. 12; Fig. 16 an elevation of another fastener and Fig. 17 a side view thereof; Fig. 18 a cross section along line **18—18** in Fig. 16; Fig. 19 a cross section with parts in elevation and Fig. 20 a top view of a member usable in connection with the modification shown in Figs. 9 to 11; and Figs. 21 and 22 cross sectional end views along line **21—21** in Fig. 20.

Referring to Figs. 1 to 6, there is supposed that two sheets or plates **12**, **13** are to be connected in a lap-joint. Plate **12** may be of any suitable material as mentioned above and form the outside wall of a wing, fuselage or any other part of an air-craft or other vessel. Plate or sheet **13** may belong to another part of such air-craft or vessel which is to be fastened to it and removed easily and readily, such as a lid or cowling to cover a man hole or other opening in the body of that air-craft or vessel. In particular, it is assumed that plate **12** and therefore plate **13** are accessible from one side only, in this case from the outside **14**.

Plate or sheet **13** is provided with a hole **16** which is extended to lateral slots or recesses **17**. Plate or sheet **12** is provided with an opening **18** of preferably circular shape the diameter of which equals or is slightly larger than the largest dimension of slots **17** plus hole **16**. On the non-accessible side of plate **12** a springy, loop-like connecting member **20** is fastened, for instance by means of rivets the heads **22** of which are large enough to completely cover the bent ends of connecting member **20**. The shanks **23** of the rivets are passed through the bent ends each of member **20** as well as holes in plate **12**. The free ends of shanks **23** form sunk heads **24** the outer surfaces of which lie flush with the outer surface of plate or sheet **12**. Member **20** may be made e. g. of springy steel wire and shaped the way shown in Figs. 5 and 6. The two lateral ends of the elongated loop formed by member **20** are curved so that shanks **23** can be passed therethrough and also lie flat on the inside surface of plate **12**. Where member **20** freely crosses hole **18**, it is somewhat bent inside the hole and provided with a dent or groove **25**. On both sides of groove **25**, upwardly projecting ramps **26** are formed. The elongated loop-like member **20** is arranged across hole **18** preferably in such a manner that its longest dimension coincides with that of slots **17** when body **13** is placed upon body **12**.

In this exemplification of the invention a fastener is used comprising a flat or well rounded head **27** provided with a kerf **28**, and a shank **29** in a transverse hole of which a pin **30** is fitted. Pin **30** and kerf **28** are preferably arranged in parallel so that the workman inserting the fastener can ascertain the position of the pin (which is invisible to him) from the position of the kerf.

If body **13** is to be fastened to body **12**, body **13** is positioned upon plate **12** in such a way that hole **16** and slots **17** register with opening **18** and, in particular, the axis of hole **16** coincides with that of hole **18**. Thereupon shank **29** of the fastener with the projecting ends of pin **30** is passed respectively through hole **16** and slots **17** from the accessible side **14** of the bodies **12**, **13** and thereafter the fastener is turned by means of a tool inserted in kerf **28** so that the projecting ends of pin **30** slide over the springy member **20** and its ramps **26**, whereby member **20** is somewhat deformed elastically and pressed inside hole **18**. After completion of a turn of about 90°, the projecting ends of pin **30** catch the grooves **25** while member **20** is preferably still somewhat deformed elastically and thereby holds firmly in place the projecting ends of pin **30**. This blocked position of the fastener and projecting ends of pin **30** is shown in Figs. 2 and 4. The connecting member **20** if elastically deformed in the locking position, presses the bodies **12**, **13** one against the other and thereby prevents relative movements thereof.

In order to facilitate the turning of the projecting ends of pin **30** over the connecting member **20**, the latter is advantageously provided with depressions **31** on both sides of ramps **26**; the depressions are preferably deeper than grooves **25** so that the ends of pin **30** do not deform member **20** when they pass over these depressions but are to press the ramps **26** downwardly and thereby elastically deform member **20**; the latter may be still so deformed when the ends of pin **30** lie in the recesses **25** which are shallower than the depressions **31**.

The arrangement according to Figs. 7 and 8 differs from that just described with reference to Figs. 1 to 6 in that the fastener is not inserted through a hole and slots in body **13** but a dish-like member **32** is provided for receiving the fastener. To this end, a preferably circular hole **33** is provided in body **13** preferably of the same size as hole **18** in body **12** (although these two holes may also be of different shape, size or diameter). The dish-like member comprises an outer flange **34** which is e. g. welded, soldered or riveted to body **13**, and an either rigid or springy center portion **35** provided with a hole **36** from which slots **37** extend radially so that somewhat springy flaps **38** are formed between them. Across hole **18** member **20** is arranged and riveted to body **12** the same way as described herein previously.

The fastener consists e. g. of a flat head **39** provided with a kerf **28**; shank **20** is grooved at **40** so as to receive the projecting ends of flaps **38** when the fastener is pressed through hole **36** the diameter of which is only slightly larger than the inner diameter of the circular groove **40**. Pin **30** is tightly fitted into a transverse hole of shank **29** and preferably arranged parallel to kerf **28** so that the position of pin **30** can be recognized from the accessible outside **14** of body **13**.

Before assembling bodies **12**, **13**, shank **29** is pressed through hole **36** and thereby fixed in its position relative to the dish-like member **32**; thereafter pin **30** is driven through the hole of shank **29**. Body **13** is then positioned upon body **12** so that holes **33** and **18** register and pin **30** is parallel to the longest dimension of the springy connecting member **20**. Upon turning the fastener by about 90°, pin **30** rides over and deforms member **20** until the projecting ends of pin **30** snap into grooves **25** of member **20**. In this locking position of pin **30** the member **20** is preferably still elastically deformed as described with reference to Figs. 1 to 6 whereby any loosening of the fastener is avoided.

It is obvious that body or plate **13** can be provided with any desired number of holes **33**, members **32** mounted in those holes and the fastener

in each member, so that each body 13 is ready for being mounted on another body 12.

Referring to Figs. 9 to 14, there is another form of fastener shown which can be used for the purposes of the invention. The fastener consists of a head 27 provided with a kerf 28, and a shank 41 the top 42 of which is rounded or tapers and is flattened on opposite sides, as to be seen best on Figs. 12, 13 and 14. The opposite flattened sides of the top portion of the shank preferably end into shallow grooves 43, and grooves 44 are provided on both front ends of that portion which are deeper than grooves 43 if the latter are present. Thus the distance between the grooves 43 is considerably smaller than that between the grooves 44, and the bottoms or apices of grooves 43 and 44, respectively, are substantially straight and parallel, resulting in a substantially rectangular cross section of the shank portion between those two pairs of grooves 43, 44. If grooves 43 are omitted, the flattened sides of top 42 extend to the cylindrical portion of shank 41 (Fig. 12*a*).

Referring to Figs. 9 and 10, plate or sheet 12 is provided with a hole 45 of slightly larger diameter than shank 41 and plate or sheet 13 is provided with a hole 33 of considerably larger diameter for receiving a dish-like member 32 of substantially the same type as shown and described above with reference to Figs. 7 and 8. The center portion 35 of that member is radially slotted and provided with a hole so that shank 41 may be pressed therethrough and the flaps formed in the center portion of dish 35 enter a circular groove 40 near the bottom end of shank 41.

Across hole 45 and on the non-accessible side of plate or sheet 12, a hairpin-like springy member 46 is mounted. A rivet is passed through the bent portion of member 46 so that an enlarged portion of its head 47 rests on and a reduced portion 47′ lies within that bent portion, while its shank 48 passes a hole in body 12 and is secured therein by means of a sunk head 49. The free ends of member 46 are slidably held in place by means of a substantially E-shaped head 50 of a rivet the shank 51 of which is riveted into a hole of body 12. Instead, a bridge can be arranged across the ends of member 46 and welded, etc., onto body 12.

It will be appreciated that the two legs of hairpin 46 can be flexed or bowed apart, and that thereby elastic stresses are caused therein.

In securing body 13 to body 12, fastener 41 is turned in a position in which the larger dimension of its flattened top portion 42 is parallel to member 46 and is then pressed through the latter whereby the legs of member 46 are somewhat deformed and bowed apart and either frictionally hold the top or snap into grooves 43 if provided. Thereby the fastener is held in place preliminarily. If no such grip of member 46 on top 42 is desired, grooves 43 are omitted and the legs of member 46 spaced so that top 42 can freely pass between them. Thereupon the fastener is forcibly turned by about 90° by inserting a tool into its kerf 28, whereby the legs of member 46 are further flexed apart, as shown in Fig. 11, and finally snap into grooves 44, as shown in Fig. 18. It will be appreciated that by the large deformation of member 46 required for turning the fastener into its blocking position and for returning it therefrom, and the great elastic stress thereby caused in member 46, furthermore by the shape of grooves 44, the fastener is firmly held in its blocked position. It is therefore possible to also hold the fastener in its blocked position with non-flexed, stress-free legs of member 46.

In order to separate again body 13 from body 12, the fastener is to be returned forcibly from its position shown in Figs. 2 and 4 by means of a tool inserted in kerf 28 whereby connecting member 20 is elastically deformed. The same way the fastener is to be returned from its position shown in Figs. 9, 10. Thereupon body 13 falls off or can be pulled off body 12, the latter if the legs of member 46 engage grooves 43 or grip the flattened sides of top 42 frictionally.

Instead of using a flattened top of the fastener as just described, its shank 52 may be cylindrical throughout and provided with one pair of parallel grooves 53 only on opposite sides below its preferably tapered or rounded off top, as shown in Figs. 16, 17 and 18. It will be appreciated that upon pressing shank 52 of the fastener through hole 45 of body 12, Figs. 9, 10, into a position in which the full cylindrical portion of shank 52 is to pass between the legs of member 46, the latter are flexed apart to the greatest extent and engage with corresponding friction the surface of the shank. Upon turning the fastener by about 90°, grooves 53 arrive in front of the legs of member 46 which snap into those grooves but still remain elastically deformed and are thereby pressed into the grooves with desired force. Grooves 53 have substantially parallel and straight bottoms and thereby lock shank 52 in its final position. In order to return the fastener to its initial position in which it was inserted, a tool is to be inserted into kerf 28 and the fastener to be turned back by about 90° with considerable force.

Instead of mounting member 46 on body 12 by means of rivets, an intermediate member can be used. This member, Figs. 19 to 22, consists of a flat center portion 55 provided with a hole 56 to be aligned with hole 45 of body 12. At one end of portion 55, a projection 57 is provided and rolled to form a lug through which member 46 can be slipped. It is also possible to roll projection 57 over the bent portion of member 46 and thereby to hold the latter firmly in place. At the opposite end of portion 55 another projection 58 is arranged in which either a single broad slot 59 or individual holes 60 are provided; projection 58 is bent upwardly as shown in the drawings. The free ends of member 46 are slipped through slot 59 or holes 60 and thereby the springy connector 46 is held in place.

Member 55 may be spot welded, soldered, or, as shown, riveted to body 12 by means of rivets 54.

It will be appreciated that any type of fastener as exemplified in Figs. 12 to 18 can be used in connection with the mounting illustrated on Figs. 19 to 22. It is also evident that the shank of the fastener may be mounted in body 13 by means of a dish-like member 50; any other shape and structure of a dish-like member and its mounting may be used for any and all purposes of the invention, such as described in my copending application Ser. #431625.

In the exemplification of the invention as shown in Figs. 9 ff. only a relatively short portion of the springy and preferably wire-like member 46 extends freely over hole 45, and thereby vibrations due to the elastic condition of that member are practically excluded.

It is understood that instead of a loop 20 or a hairpin-like member 46 also two separate springy wires can be arranged across hole 18 or 45 and held in place by bridges 50 engaging the ends of the individual wires on opposite sides of the hole. In such event a mounting member as shown in Figs. 20, 21 will be used to advantage, the center portion of which is provided however on both ends with upwardly bent portions 58 so that the end of each wire can be slipped through an individual hole 60. In order to prevent any such wire to fall out of holes 60 its projecting ends may be broadened or flattened by pressure, such as a hammer blow, in the cold. The same way slipping out of individual wires from bridge 50 can be prevented. In order to prevent undesirable turning of the individual wires within their holders, one end of each wire may be soldered or welded to its holder or spun over the latter.

It is to be understood that the invention is not limited to any exemplification herein before described and shown in the drawings but is to be derived in its broadest aspects from the appended claims. Its outstanding features and advantages are the following: A number, two as a minimum, of elastic connecting members are arranged on one (the non-accessible) side of the bodies to be joined across the registering holes thereof and mounted on the non-accessible body outside its hole. A proper fastener is to be inserted from one (accessible) side of the bodies in a predetermined initial position relative to the connecting members in which its shank meets only slight or no obstruction at all to its passing these members; when so inserted and turned thereafter by a predetermined minimum angle, the fastener elastically deforms the connecting members and is eventually blocked by them. From this blocking position the fastener can be returned to its initial position in which the bodies can be separated, only by a force sufficient to elastically deform the connecting members. To these effects the shank of the fastener is provided near its free end with means capable of engaging the connecting members and to elastically deform them only while the fastener is being turned from its initial to its blocking position and vice versa; these means may also, if desired, so deform the members in the blocking position but are in any event clear of them in the initial position. These engaging means may consist either in projections, Figs. 1 through 7, or recesses, Figs. 9 through 20. The grip of the fastener is defined by the distance of the engaging means from the adjacent surface of its head, and equals or is somewhat smaller than the distance of the portions of the connecting members engaged by the projections or recesses of the shank in their blocking position from a surface of the joined bodies engaged by the head of the fastener. If the grip of the fastener equals that other distance, the connecting members 20, Figs. 1 through 7 are not elastically deformed in the blocking position, while the members 46, Figs. 9 to 20, are so deformed in the locking position but substantially in a direction crossing that of the forces tending to separate the joined bodies. If the grip of the fastener is somewhat smaller than that other distance, the members 20 and 46 are elastically deformed in the blocking position which in the first case additionally secures the engaging means (projections 30) in their blocked position and in all cases counteracts relative vibrations of the joined bodies. In all cases, too, the fastener is to be turned back from its blocked position with considerable force (in a direction crossing that of any force acting during use upon and tending to separate the joined bodies) in order to elastically deform the connecting members and thereby unlock the engaging means 30, 44 or 53.

Particular advantages of the invention consist in its simplicity and inexpensiveness; the elements used do not project objectionally beyond the outer surfaces of the bodies; the connecting members may be arranged, as shown, substantially parallel in pairs and thereby in the blocking position engage the shank from symmetrically opposite sides; and the connecting members may also be arranged so as to engage the shank in its initial position with slight friction or in shallow recesses 43 arranged at smaller distance than the blocking recesses 44 whereby the assembly of the bodies is sometimes facilitated.

FRITZ v. OPEL.

PUBLISHED	F. VON OPEL	Serial No.
JUNE 1, 1943.	FASTENING DEVICES	447,499
BY A. P. C.	Filed June 18, 1942	3 Sheets-Sheet 1

Fig. 1.

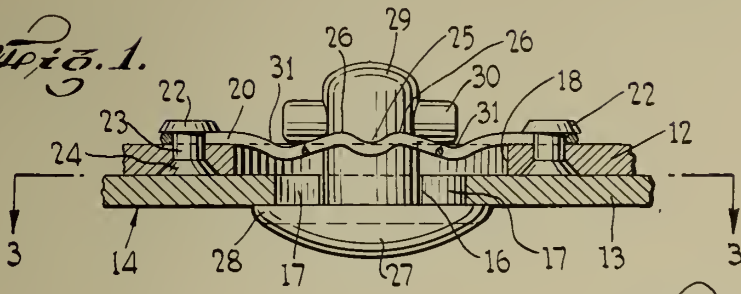


Fig. 2.

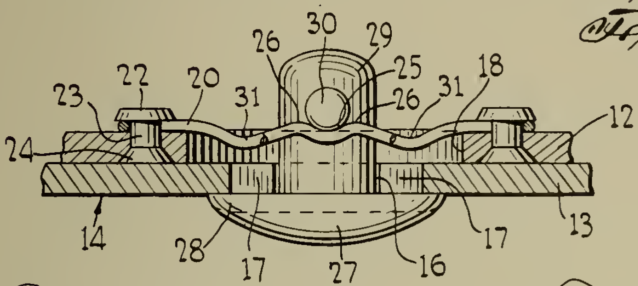


Fig. 3.

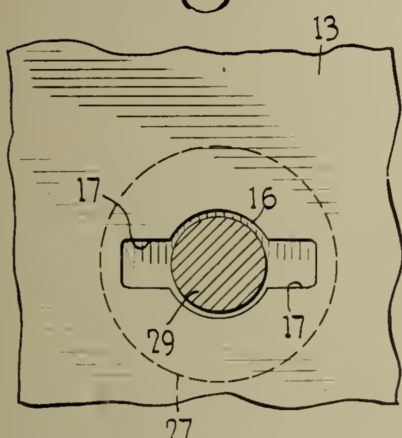


Fig. 4.

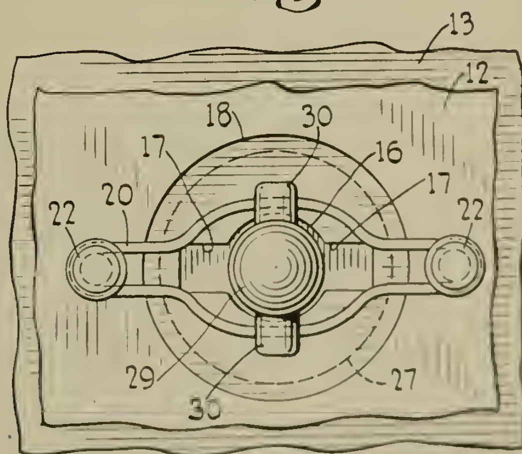


Fig. 5.

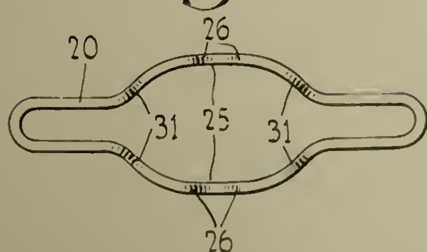
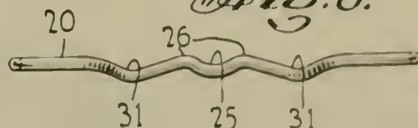


Fig. 6.



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PUBLISHED	F. VON OPEL	Serial No.
JUNE 1, 1943.	FASTENING DEVICES	447,499
BY A. P. C.	Filed June 18, 1942	3 Sheets-Sheet 2

Fig. 7.

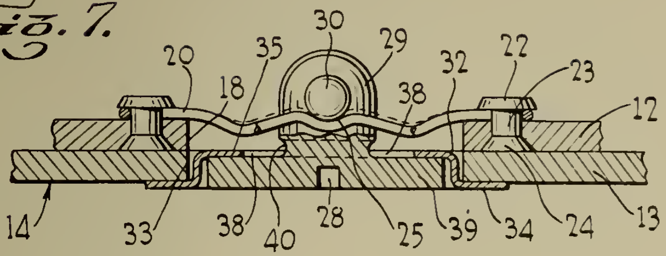


Fig. 9.

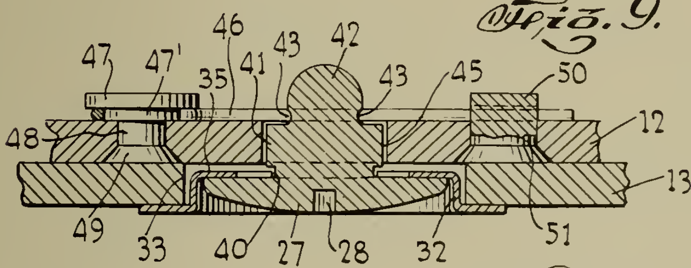


Fig. 8.

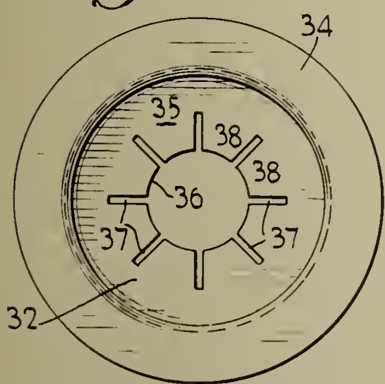
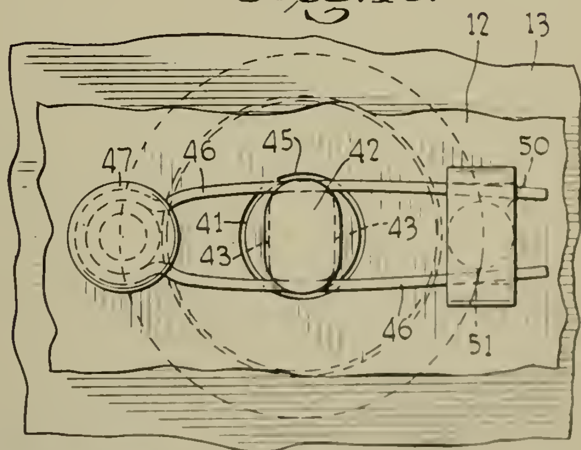


Fig. 10.



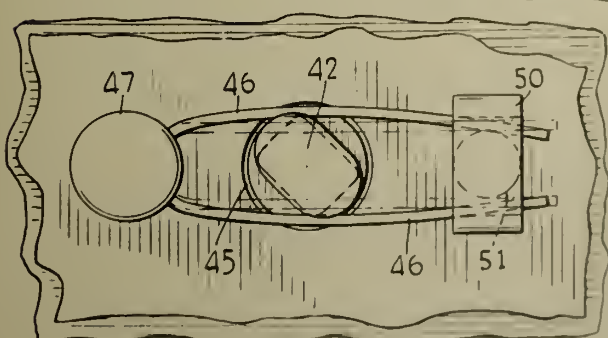


Fig. 11.

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Fig. 12a.

Fig. 12.

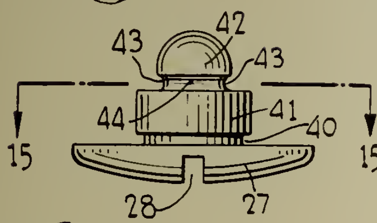


Fig. 13.

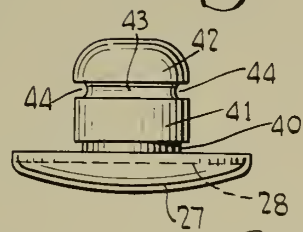


Fig. 14.

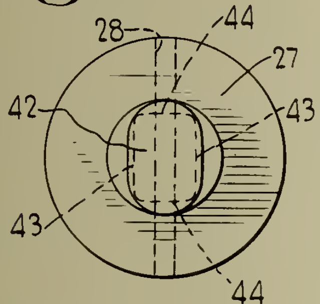


Fig. 16.

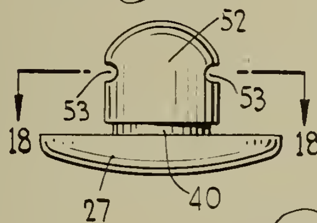


Fig. 17.

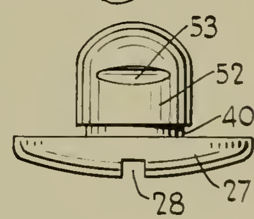


Fig. 19.

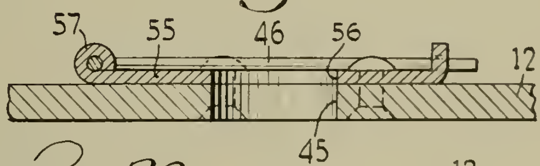


Fig. 15.

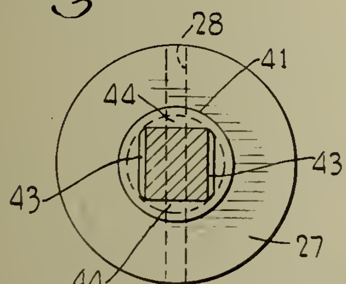


Fig. 20.

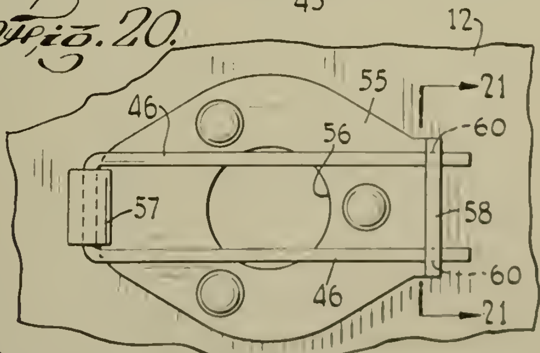
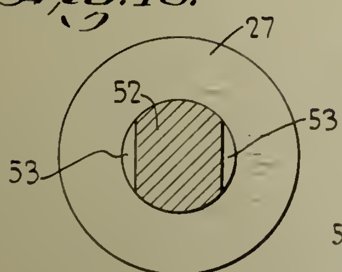


Fig. 18.



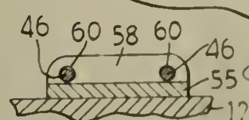
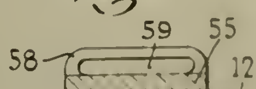


Fig. 21.

Fig. 22.



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Published June 1, 1943

Serial No. 449,538

ALIEN PROPERTY CUSTODIAN

PROCESS FOR THE PREPARATION OF AGGLOMERATES

Georges Levy, Avignon, France; vested in the Alien Property Custodian

No Drawing. Application filed June 29, 1942

It is known that alcaline silicates of various chemical compositions may be used as agglomerating agents for various substances. These silicates, however, do not exert their effect immediately, and the products thus obtained must be subjected to drying, generally for a long time, at temperatures between 150 and 300° C. Many chemical compounds have been over and again proposed for reducing the binding time of silicates and the heating time required for hardening the agglomerates.

The applicant has found that it is possible to eliminate entirely the drying operation by using silicates belonging to a particular class and presenting certain characteristic physical properties. These silicates correspond to solutions of various concentrations, with various values of the ratio SiO_2/Na_2O, but such that:

1. Subjected to natural evaporation, in a thin layer, they will yield a residue in the form of a supple, thin, elastic film, entirely different from the hard aggregates, difficultly scratchable, given by the silicates usually used and in which the SiO_2/Na_2O ratio is generally high. The silicates proper for use in the method according to the present invention must have a SiO_2/Na_2O ratio ranging from 1.9 to 3.1, and preferably from 1.9 to 2.8, and

2. The viscosity of the solutions of these silicates lies between perfectly defined limits, varying with the nature of the body it is required to bind and with the conditions of agglomeration; the viscosity of the solutions usable according to the invention must be higher than 100 centipoises.

The silicates with a molecular ratio SiO_2/Na_2O ranging from 1.9 to 2.8, particularly, possess the following properties:

a. They permit to adjust easily, by concentration, before and after mixture with the products to be agglomerated, the viscosity to a value such that when the products are taken out of the molds, their cohesion is sufficient, without any risk of the drawbacks usually encountered, due to a too sudden solidification of the agglomerating agent.

b. They are more stable than the silicates with a high percentage of silica (higher than 3.1); the decomposition of the latter is set up more easily by a great number of different substances, and, especially by the substances contained in the products to agglomerate. They yield in this case a gelatinous silica which, when dry, has only a weak agglomerating power. The silicates with a molecular ratio SiO_2/Na_2O ranging from 1.9 to 3.1, on the contrary, decompose only much more difficultly.

An advantageous method for carrying into practice the process according to the invention is to subject the paste formed by the substance to agglomerate and the solution of alcaline silicate to a first heating adapted to bring the paste to a well determined state of dryness (moisture contents of from 2 to 4%), corresponding to a sufficiently high viscosity of the silicate, without however attaining complete dryness of the product.

The binding of the silicates may be accelerated by the use of catalysers reducing the time necessary for the cohesion to attain a sufficient degree. The proportion of catalyser to be introduced depends upon the characteristics of the silicate used, upon the particular operating conditions, as well as upon the nature and use of the agglomerates desired. It is possible to do away entirely with the catalysers by using silicates suitably chosen, and particularly silicates having a SiO_2/Na_2O ratio lying between 2 and 2.6.

The catalysers proposed must belong to the group of wetting or emulsifying agents, or of bodies having an active radical setting up a superficial concentration of the silicate in their immediate neighbourhood and, consequently, the formation of a film having all the characteristics of the coagulum defined above. It is, on the contrary, important to exclude, whatever the class of silicates adopted, all the bodies bringing about a binding of the silicate in a massive form or in the form of clots of variable hardness.

The above invention applies to the agglomeration by means of silicates, of a very great variety of substances, such as various sorts of coal, ores, foundry sand, road coverings etc.

The following examples are given as an indication, without any limitative character whatsoever:

Example 1

Coal of any sort, anthracitous, bituminous or other, is mixed with 10% of sodium silicate having a SiO_2/Na_2O ratio of 2.7, in solution at 51° Bé, and with 0.25% of a wetting agent such as a sulphonated naphthaline. The paste is heated up to suitable dryness at a temperature ranging from 50 to 95° C, and subjected to pressure in a hydraulic press or a ball press.

At their issue from the press, the agglomerates have a suitable cohesion, permitting to load them directly into trucks. The cohesion increases rapidly with time for attaining a maximum after about one hour.

Example 2

An anthracitous, bituminous or other coal is mixed with 10% of sodium silicate having a SiO_2/Na_2O ratio of 2.2, in solution at 55° Bé, the operation being effected in a mixing screw. The paste obtained is dried at 80–85° C and compressed without adding any catalyser. At their issue from the press, the agglomerates may be immediately loaded on trucks.

GEORGES LEVY.

Published June 1, 1943

Serial No. 450,223

ALIEN PROPERTY CUSTODIAN

BOARD-JOINING PROCESS BY OSMOTIC PLUGS, MORE ESPECIALLY UTILIZED IN LIGHT-TIMBER FRAME-WORK

Jacques Couëlle, Marseilles, France; vested in the Alien Property Custodian

Application filed July 8, 1942

The chief object of this invention is to carry out a process by which it becomes possible simultaneously to maintain hygrometric poise in wood together with board-joining, more especially in frame-work and known assemblage of beams, by solely making use of certain plugs of a specific texture and fixing them up in such a way as to replace, first, the medullar system feeding wood through osmotic pressure, and, secondly, all iron-pins, screws or nails that are now utilised to bind up assembled pieces.

The fixing of osmotic plugs being essentially meant to obtain a kind of hygrometric drainage tending to replace the natural process found in live wood.

In order to better understand the characteristics of this invention, the chief elements serving to its fulfilment are shown on the drawings of instructions here-attached.

These drawings are showing, respectively:

Plate No. 1—An elevation-view of a longitudinal section of the elements composing trees in general.

Plate No. 2—Same section in flat.

Plate No. 3—A face-view, on a smaller scale, of a tree trunk and its usual cutting up.

Plates No. 4, 5 and 6—Such deformations, respectively, as may occur in boards cut up from trunk seen on Plate No. 3.

Plate No. 7—A face-view, on a wider scale, of two boards coupled by means of osmotic plugs (main feature of this invention).

Plate No. 8—A side-view of same boards and the grouping of osmotic plugs.

Wood, as one knows, is a fibrous body composed of cells turned into a determined direction by stringy filaments 1, Plates Nos. 1 and 2. These fibres are elongated and running parallel with the axis of the tree, they are disposed into concentric layers 2 of different thicknesses and densities corresponding to various climates, qualities and also to periods of vegetation and of rest. It is owing to these concentric layers that the age of a tree can fairly accurately be determined.

Parallel with the ligneous layers are to be found grooves forming sap ducts 3. The ligneous filaments 1 which constitute the wood itself are in certain parts crossed by an assemblage of directive lines called medullar rays 4: these rays 4 start their course from the bark tissue and converge in the vicinity of the medulla 6 but do not all get as far; they vary in length and thickness according to density of sap; it is also due to them that the wood is kept alive; acting as regulators, they distribute all feeding matter by osmose to fibres and cells, the constitution of which being made of very hygroscopic colloidal matter, that is to say retaining any water whilst ensuring equilibrium by means of atmospheric humidity. But this is no longer the case directly the wood is sliced into boards (7 to 17—Plate 3). At that moment, the medullar rays 4 are cut off and the water is drained to and retained in the fibres, thus causing variations as to shape, density and resistance: the wood swells out and retracts, alteration commonly known as "warping" (as shown in Plates 4, 5 and 6) and always closely following up the incurvations of the ligneous filaments 2 which may truly be compared here to springs.

Alike metal, whenever it be utilised in constructions, wood is likely to warp through tractions or compressions; its mechanical just as its physical properties are different ones, according to whether it is being worked along its axis (wood grain), or transversally (sideway). Consequently, its axle cohesion differs from its transversal cohesion. As a matter of fact, it is easier to separate ligneous fibres lengthwise than transversally, and it could be said, by analogy, that wood is essentially anisotropic.

It is therefore recognized that, in nature, the state of poise of all matter forming the very texture of wood is due to the preservation of its hygroscopic state, as being ensured through the medullar ducts 4 which bring about the osmose feature.

Yet, if two boards, once cut, are being placed one against the other (18 and 19—Plates and 8), and that, in order they should hold fast, minute holes are bored into 20 preferably at various angles, also that, through such tiny holes, plugs 21 the size of a big match stick of tender wood are forced in, a system of drainage by osmose is thus artificially created; further, we find that this will preserve the hygrometric equilibrium within the ligneous fibres 1 of the boards in question, just as would the medullar ducts in nature. In multiplying those plugs 21, there will thus be simultaneously created medullar ducts together with a system of fixture of the highest resistance—(experimentations demonstrated that it is practically impossible to separate two boards assembled thus)—which will enable to utilise such an assemblage with a maximum of both security and convenience; and this process of fixture by plugs 21 will ensure permanent airing of the fibres, whilst recreating as perfectly as possible the necessary cohesion between the boards 18 and 19, without affecting in any way the resistance

(the nerve), all of which considerably increases the coefficient of resistance in case of rupture of a wooden frame-work assembled thus.

Such result, held as being a new one, characterises and justifies this invention. It permits a setting up, with yet more precision, of the foliated wood frame-works patented by the same inventor, devices which already help to adjust, if only partially, certain variations in densities between the elements used, variations which had been found in trees in particular circumstances during growth.

Those partial adjustments are made possible through a juxtaposition of boards of different grains, but which are always held together by metallic parts, cutting in and completely obstructing all circulation through the fibres, and creating points of rupture wherever detents or cuts are made.

Summary

Board joining process by osmotic plugs, more especially utilised in light-timber frame-work, characterised by:

1. Holes bored into boards to be fitted together. These holes of very small diameter are placed at various angles and in opposite directions to each other. It is better to place these tiny slanting perforations in quincunx.

2. Plugs, which must essentially be of more tender wood than that of the boards, are forced into the above-mentioned perforations.

3. Combination and cooperation of the mentioned holes and plugs, in order to constitute an artificial medullar duct to feed the fibres of the boards, simultaneously with a system of fixture and assemblage of the boards treated thus.

JACQUES COUËLLE.

PUBLISHED
JUNE 1, 1943.
BY A. P. C.

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BOARD-JOINING PROCESS BY OSMOTIC PLUGS, MORE ESPECIALLY UTILIZED IN LIGHT-TIMBER FRAME-WORK
Filed July 8, 1942

Serial No.
450,223

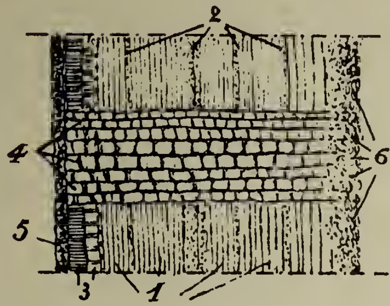


Fig. 1.

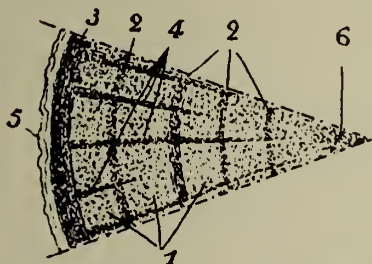


Fig. 2.

Fig. 3

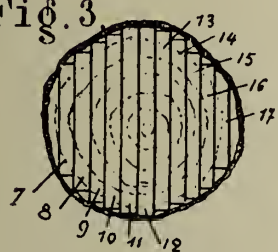
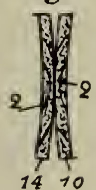
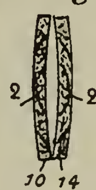
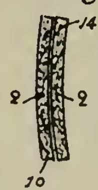


Fig. 4. Fig. 5. Fig. 6.







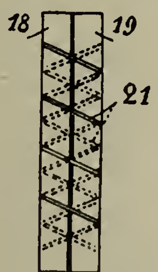


Fig 7

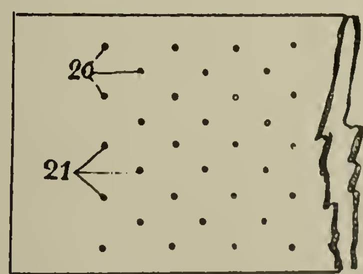


Fig. 8.

Published June 1, 1943

Serial No. 450,224

ALIEN PROPERTY CUSTODIAN

PROCESS OF RAPID ESTABLISHMENT OF LIGHT CONSTRUCTION BY COMBINATION OF STANDARD PANELS WITH SUPPORTING FRAMEWORKS

Jacques Couëlle, Marseilles, France; vested in the Alien Property Custodian

Application filed July 8, 1942

There are vital and imperative circumstances which require rapid establishment of constructions intended to shelter in the possibly best conditions of hygiene and comfort, a great number of persons, such as they proceed, chiefly in wartime, from the exodus of the populations of invaded countries number which of the reaches a very great importance.

In such cases, difficulties, great enough, have until now, arisen from sheltering refugees, because the present means of providing such kinds of quickly built constructions are not proceeding from new processes, and it is therefore materially impossible to erect, in a minimum of time, even rustic barracks.

Such difficulties are now avoided by the object of the present invention which consists in a process of quick and inexpensive establishment of light constructions with the chief purpose of gathering and sheltering in shortest time refugees, wounded troops, etc. This process is characterized by the fact that it makes essentially use of panels forming partitions which fulfill the office of walls and roofs, and which are more favourably constituted by reed-canes, which allows to give any rectilinear broken or curved forms to those panels established and mounted according to standard dimensions so as to fit without any adjustment between the supporting frameworks disposed to that effect in order to constitute simultaneously elements of vertical or inclined partitions as well as elements of rectilinear or curvilinear cover.

The pricipal elements characterizing the process are represented on the annexed drawing, given as an explanation and likewise as an example of execution of one of the forms which can be taken by a light construction erected on this process, construction being the object of the present invention.

According to this drawing:

Fig. 1 shows seen in perspective, an element of rectilinear forms and standard dimensions with cut parts in order to facilitate the constructive understanding.

Fig. 2 shows seen in perspective an element likewise of standard forms and dimensions of curved form.

Figs. 3, 4 and 5 show respectively seen from the side the superposition of those curvilinear and rectilinear elements in order to realize light constructions in curved, rectilinear or broken forms.

Fig. 6 shows seen in perspective and partly, a whole realized by the process, in which one recognizes the combination of the reed-cane panels with supporting frameworks.

The elements forming standard panels are more favourably constituted of reed-canes 1, because these offer multiple advantages, first as to the cost-price, secondly as to lightness and solidity, to which advantages those of insonority and isother and finally, of a great simplicity in their erection, are to be added.

These reed-canes are assembled according to economical proceedings. They are cut and fastened together according to previously fixed dimensions, then they are more favourably covered on one of their faces with a coating 2 of plaster affixed preferably by mechanical projection (principle of tyrolian).

The surface of the panel thus obtained, intended to be put outside the construction is afterwards entirely covered with a protecting coating, impervious to humidity, based on tar, petrol residue or any other similar product fulfilling the same purpose.

Those panels which by the very disposition of the reed-canes mounting and by the forms give to it, will be able to be made at the manufacture, which will facilitate the construction of the shelter. This possibility constitutes one of the chief characteristics of the invention.

These reed-cane panels may take any desired forms, two principals of which are shown on the Figs. 1 and 2, and so they may suit the confection of standard element able to be fixed on any kinds of supports and more particularly on supporting frameworks A, as shown on Fig. 6.

In that, not at all limitative example, the frameworks are constituted by two boards 4 and 5 coupled to each other according to previously given section angles, and fastened together by the means of bolts 6, so as to remain dismountable later on. Between these boards 4 and 5 are placed metal corner plates 7 of feeble thickness, and fish-plates 8, both of them presenting the particularity of having unevennesses 9 obtained by refulling the metal; these roughenesses 9 having the object of constituting as many catching surfaces owing to their penetration on the internal sides of the boards and thus to secure a better fastening of the whole.

The boards 10 and 11, disposed horizontally, form cross pieces maintaining the separation of the supporting framework A formed by the assemblage of the boards 4 and 5. They are likewise fastened together by screws or other similar known means. That whole, constituted of the boards 4 and 5 and 10 and 11, form the timber

work of the construction, partly shown on Fig. 6 on which will be fixed, by likewise known means, the standard panels constituted according to those shown on the Figs. 1 and 2.

These panels; the exterior junction lines which will be obturated with flexible strips 14, indicated by dotted lines on Fig. 1, covered or not with an insulating coating, can be propped on metal threads 12 constituting wind bracings to this whole; they may likewise be covered with a coating of plaster paint or other. An empty insulation space may be obtained by affixing panels 13 to the inside of the supporting frameworks A.

In this example of construction, it is also shown that the utilization of standard panels does not impede the utilization of the opening B the sides of which outside of the forepart, are covered with plates 14 constituted of proper materials and that they fit with all their advantages to numerous types of constructions such as those represented on the Figs. 3, 4 and 5, and so are correspondent to every requirements and attributions incumbent to that kind of constructions. Thus, dimensions and forms of the panels shown on Figs. 1 and 2 may vary without changing the industrial outcome obtained.

JACQUES COUËLLE.

PUBLISHED

JUNE 1, 1943.

BY A. P. C.

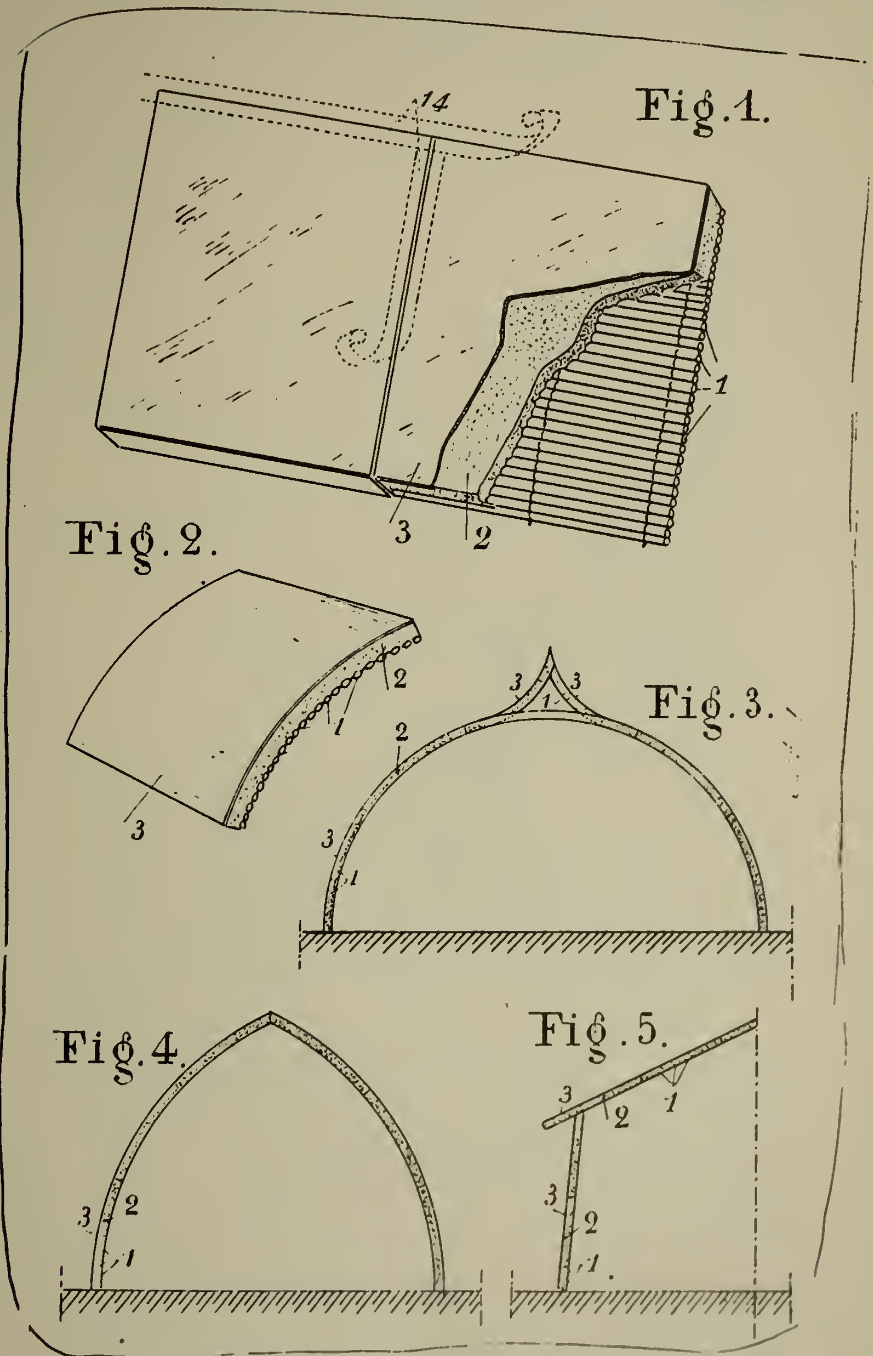
J. COUËLLE

PROCESS OF RAPID ESTABLISHMENT OF LIGHT CONSTRUCTION BY COMBINATION OF STANDARD PANELS WITH SUPPORTING FRAMEWORKS

Filed July 8, 1942

Serial No. 450,224

2 Sheets–Sheet 1



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Serial No. 450,224

2 Sheets-Sheet 2

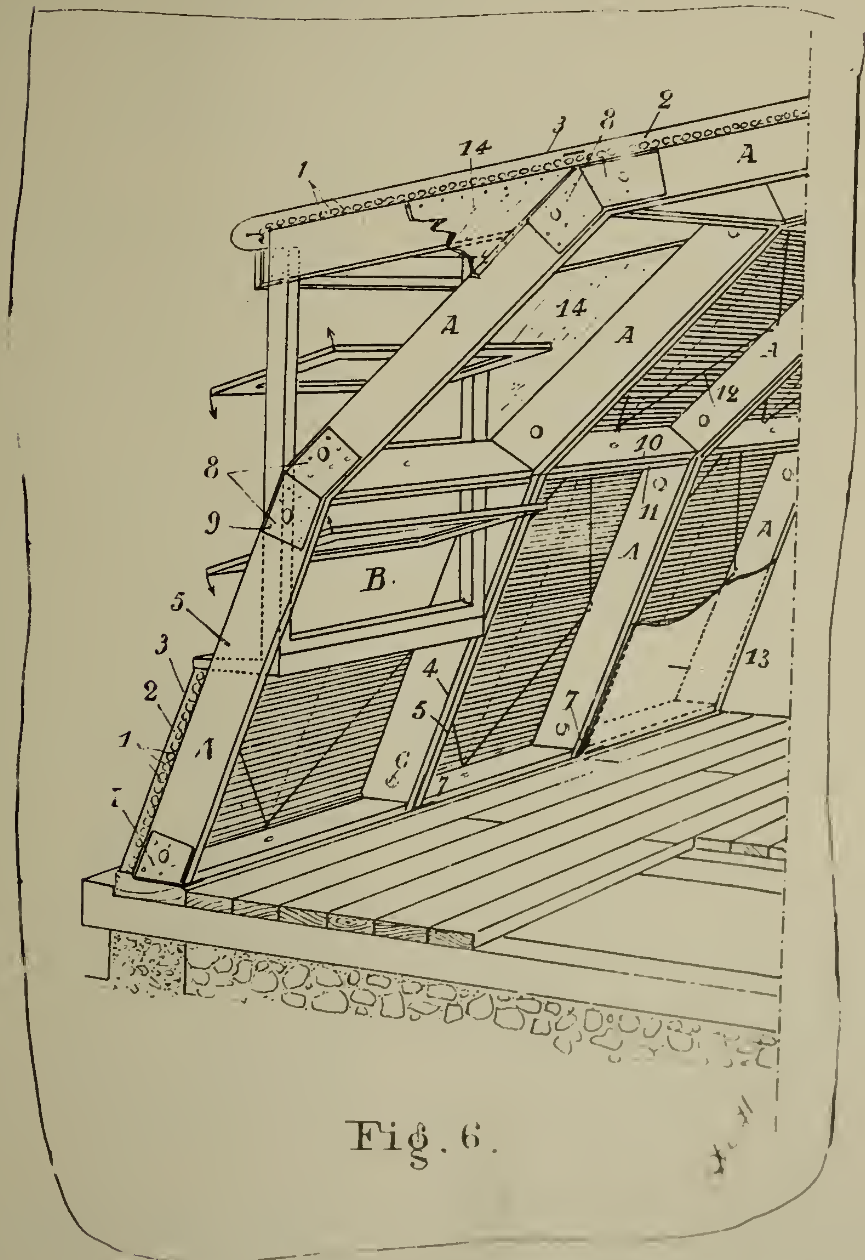

Fig. 6.

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ALIEN PROPERTY CUSTODIAN

POLYENGINE BIPROPELLER GROUP FOR AERODYNES

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Application filed July 14, 1942

My invention has for its object to provide a polyengine and bipropeller group. Two-engine and two-propeller groups are known in which two coaxial propellers are driven in opposite directions, the first by one of the engine, the second by another. These two engines rotate generally in opposite directions. On the other hand, the torques of the two propellers may only be mutually cancelled if they are equal at every instant. When an engine does not run the torque of the rotating propeller is no longer counerbalanced and unbalances the airplane, particularly in the case of a central two-engine group; the torque requires then to be corrected through the controls; the propeller of the stopped engine exerts a substantial drag upon the forward motion, and the general fineness of the machine is decreased just when only a part of the power is available.

On the other hand, in the case of variable pitch propellers, as the speeds of the two propellers are not constantly in the same ratio, two independent controls must be provided for adjusting the pitch.

The object of the present invention is, inter alia, to remedy, at least in part, to the aforesaid failings and to increase the efficiency of the engine-propeller group and that of the aerodyne, particularly in case of stopping of one of the engines of the group, which may comprise any number of engines.

For this purpose, in a polyengine-bipropeller according to this invention, each of the engines is connected to both propellers, preferably rotating in opposite directions, so that each of these propellers is driven simultaneously by the various engines, through the medium of transmission means comprising, inserted between each engine and the propeller assembly, elements which are proper to this particular engine and allow of the driving member of said elements being stopped while permitting the rotation of the driven member.

In such conditions, whichever the stopped engine may be, both propellers continue to be driven by the remaining power of the group and their torques may remain in the same ratio. On the other hand the various engines may be engines rotating in the same direction.

In the ambit of this generic arrangement resulting from the generic inventive idea a number of embodiments are possible.

The said elements may consist in free-wheel devices or other one-way connections but, preferably, couplings controlled either by hand or automatically will be used, the automatic control being effected, for example, under the control of a member whose position is varied in accordance with a force which results from the engine operation, such as a force provided, for example, by a fluid compressed by the engine, an electric current generated when the engine is running, etc.

In a particular embodiment the two propeller shafts are connected together by a motion reversing gear comprising an intermediate shaft and one of these propeller shafts is connected to all of the various engines.

A further object of the invention is to reduce the braking of two propellers on the running engines when one of the engines is not rotating, in order that the portion of power still available may drive these propellers at a speed approximating that of the engines of the group in normal use.

In a particular arrangement the means used therefor consist simply in using variable pitch propellers.

In another embodiment, there is inserted a variable speed gear between each engine and the set of the two-propellers in a known manner per se.

In this way fixed pitch propellers may be used without overbraking the engines should one or several of them be caused to stop. This arrangement may also be combined with variable pitch propellers.

In another embodiment again, the propeller set is driven through the medium of the planet-pinion carrier of a differential gear, one of whose sun wheels is driven by one half of the engines and the other by the second half, means being provided for stopping, preferably automatically, the sun wheel connected to the stopped engine.

A still further object of the invention is to control automatically these means adapted to reduce the braking action of the propellers on the engines in case of stopping of one engine. Such control may be made by hand or automatically, such as by similar means to those used as abovementioned for controlling the couplings, all these details being further features of this invention.

In the simple case of a polyengine and bipropeller group without variable speed gear, one automatic pitch regulating device only may be provided for the propellers of this group, which device would be connected simultaneously with the various engines, being, for example, driven from any one of the propeller shafts, whether the propellers rotate at the same speed or at different speeds.

Alike would be the conditions when the variable speed gear which is inserted between the two propellers and the various engines, is common to the whole of the latter, said gear being then

driven from one of the driving members of the variable speed gear.

As examples which are in nowise limitative several embodiments of the general arrangement which is the object of the present invention are schematically shown on the annexed drawings in the case of two engines.

In these drawings:

Fig. 1 shows a simple arrangement.

Fig. 2 shows another embodiment in which each propeller is driven by both engines through the medium of a variable speed gear.

Fig. 3 shows an alternative to Fig. 2, in which a single variable speed gear is arranged between the propellers and the various engines.

Fig. 4 shows a third modification in which the engines are connected to the propeller assembly by means of a differential gear.

Fig. 5 shows an alternative to the arrangement of the engine whatever may be the way they are connected to the propellers.

In the example of Fig. 1, the concentric shafts 1 and 2 of the two propellers are connected to each other by a reversing gear here shown as comprising two bevel gears 5 and 6 respectively keyed opposite each other on said propeller shafts 1, 2 and at least one bevel gear 7 meshing with both said bevel gears and carried by a stationary shaft 8. The inner shaft 1 is provided with a rearward extension carrying a gear 11 in mesh with two other smaller gears 12 and 13 arranged to rotate as one with the driven part of couplings 14, 15, respectively, assumed here to be claw clutches and provided with hand controls 16, 17; the driving part of these clutches being carried by a corresponding shaft 18, 19, respectively. The whole of the above-mentioned elements is arranged in a case 20 from which project only the ends of the two shafts 18, 19, which are respectively connected to two engines 21, 22, by means of transmission shafts 23, 24 and cardan joints 25 at the end of each of said shafts.

It is thus apparent that the two propellers 3 and 4 are compelled by the reversing gear 5, 6, 7 to rotate at the same speed and in opposite directions, while sharing the total torque applied to the common driving shaft, constituted here by the rear part of the inner propeller shaft. If both propellers have been designed to take the same torque at a common speed, such as, for example, that speed which corresponds to the normal operation of the engines, account being taken of their relative position, the two torques will be exactly balanced. On the other hand the two engines rotate in the same direction.

Should any one of the engines stop, the two propellers continue to be driven at the same speed and, in order that the engine speed may not be too much reduced from the normal, it is preferable that the propellers are of the variable pitch type and that their pitch be varied, either automatically or by hand, which may be carried out through a number of known means. Thus, for example, as pitch varying mechanism for the two propellers one may advantageously use that described in U. S. Patent No. 2,236,841 and U. S. Patent application No. 306,564, filed in the name of the present applicant and entitled "Variable pitch aerial propellers." This mechanism has been schematically shown and its various members are indicated at 26. The automatic control of this mechanism may be effected by means of a centrifugal governor of a known type, not shown, connected to both engines, this governor being, for example, driven from one of the elements of the transmission common to both engines.

When one of the engines has stopped, it is uncoupled by means of the mechanisms 14—16 or 15—17, which may, if desired, be automatically controlled by known means, such as, for example, under the influence of a movable member acted upon by a force resulting from the engine operation, such as a force produced by a fluid maintained under pressure by the engine, an electric current generated by a generator driven by said engine, etc.

In the example of embodiment of Fig. 2, the two propeller shafts are connected to each other by a reversing gear driven by means of two reducers, the same as in the preceding example, the only difference being that a variable speed gear is inserted between the coupling 14a, 15a and the corresponding reducer 12—11, 13—11. These variable speed gears are here of the epicyclic type with conical planet pinions, and each of them comprises a planet pinion carrier 30, on the shaft 31 of which is keyed the pinion 12, 13 of the corresponding reducing gear. The planet pinions 32 mesh simultaneously with sun wheels 33, 34 of different diameters, the largest of which, 33, rotates as one with the driven part of the coupling 14a, 15a and the smallest, 34, rotates as one with a sleeve 35 freely carried by the shaft 30 and on which is slidingly splined a clutch sleeve 36 which may be shifted by means of a control mechanism 39, 40 so as to be brought selectively into mesh either with a corresponding set of teeth 37 of the pinion wheel 12, 13 or with a fixed toothing 38 carried by the case. Preferably, as shown, the control mechanism 39, 40 of the variable speed gear of one of the engines 21, 22 is conjugated, as shown, to the control mechanism 17a, 16a of the coupling 15a 14a of the other engine, though it might also be independent.

When both engines 21, 22 rotate and are in gear, each of the clutch sleeves 36 of the two variable speed gears is in mesh with the claws 37 of the corresponding pinions 12, 13. The latter are thus directly connected with the sun wheels 34, which are consequently made unmovable with regard to the planet pinions, and each epicyclic assembly turns as a block, the propellers being thus directly driven by the engines. By unclutching one of the engines 21, 22, that of the controls 39, 40 of the variable speed gears which is associated with the operated uncoupling control 17a or 16a, will disengage the corresponding clutch sleeve 36 from the claws of pinion 12 or 13 and brings it into engagement with the fixed set of teeth 38 of the case 20. The sun wheel 34 is thus released from the planet pinion carrier 30, which may then rotate relatively to said sun wheel, and secured to the case. Speed reducing is consequently effected.

By a proper design one may so choose the reducing gear ratio that the engine which remained alone in operation rotates at a speed approximating its normal value, while the propellers, the pitch of which may then be fixed, turn at a slower speed. There may be an advantage in using also variable pitch propellers, as this permits of choosing a reducing ratio and a pitch which, by their combination, assures a good adaptation of the propellers to the various conditions of operation. If an automatic pitch control is effected by means of a centrifugal governor, so that the speed of the engines may be maintained substantially constant, two centrifu-

gal governors, **42**, of a known type, may be used, as here shown schematically, one of them being driven by one of the engines and the second by the other engine, only one of these governors **42** being in operation at any time; for example, as shown, these governors act upon the pitch varying mechanism **26** by means of electric circuits **43** leading to a reversing switch **44** which will close the one or the other of said circuits in dependence on the running or the stopping of a given engine, for example on account of it being connected to the coupling control of one of the engines, so that it may be controlled thereby, i. e. here by the control **17***a*.

One may also use a single adjustable governor driven from any one of the propeller shafts, or again a single governor—adjustable or not—connected to each of the engines through the medium of free-wheel devices.

In the alternative embodiment shown in Fig. 3, there is used only one variable speed gear which is then common to the various engines. The propellers are connected to each other through a reversing gear, as in Figs. 1 and 2, and the engines drive through transmission shafts and cardan devices, as in Figs. 1 and 2, couplings **14***b* and **15***b*, similar to the couplings **14** and **15** of Fig. 1, and pinions **12***b* and **13***b*, similar to pinions **12** and **13**, said pinions **12***b* and **13***b* meshing with a common wheel **46** which is freely supported coaxially with the propellers and carries a set of teeth **47** meshing with conical planet pinions **48** supported by means of arms **49** on the inner propeller shaft **1**. Said planet pinions **48** gear besides with a smaller wheel **50** loose on the shaft **1** and on said wheel is slidingly keyed a clutching sleeve **51** having two sets of claws adapted to be brought by sliding motion of the sleeve **51** into engagement either will a set of claws **52** fast with the shaft **1**, or with a set of claws **53** fast with the case **20***b*. The operation of this variable speed gear is similar to that of the variable speed gear shown in Fig. 2. Shifting of the sleeve **51** is effected by means of a control **54** connected by rods and links **55** to both unclutching controls **15***b* and **17***b* so that uncoupling of any one of the engines causes the sleeve **51** to be brought into engagement with the claws **53**.

This modification, though simpler than that of Fig. 2, gives the same results as the latter and lends itself to the same combinations. Moreover, if variable pitch propellers are used the pitch of which is automatically controlled by means of a centrifugal governor, only one centrifugal governor is needed. Fig. 3 shows a way of mounting the same. Said governor **56** is housed in the case **20***b* and carries a pinion **57** meshing with a pinion **58** integral with the wheel **46**, i. e. the driving member of the variable speed gear consisting of the members **46** to **53**.

In the modification of Fig. 4, the pinion **5** driving the reversing gear, by means of which the two propellers are again connected together, as in the preceding examples, is integrally connected with the planet pinion carrier **61** to partake of the rotation thereof, the conical planet pinion **62** meshing with two coaxial sun wheels **63**, **64**, which are of the same size and keyed on concentric shafts **65**, **66**, respectively. On these shafts are also secured toothed wheels **67** and **68**, respectively, which mesh respectively with a pinion **69**, keyed on the shaft coming from the engine **21**, and a pinion **70**, secured to the shaft coming from the engine **22**. The gearings **69—67** and **70—68** constitute reducing gears.

The assembly **62—66**, thus constituted, forms a differential gear whose planets-carrier **61** rotates at a speed which is the mean of the speeds of the sun wheels **63**, **64**. In case of stopping of any one of the engines, the planets-carrier **61** will rotate at a speed which is the half of that of the sun wheel still rotating. The speed of the propellers is thus reduced by one half, and it will be necessary, the same as in the case of Fig. 1, that their pitch may be varied, though the reason for doing so, in the present case, is to avoid racing of the remaining engine by increasing the pitch. In order to prevent the stopped engine from rotating in the opposite direction to its normal direction of rotation, this embodiment according to Fig. 4 is preferably completed by the provision of means permitting to stop selectively the sun wheels of the differential gear. These means consist as shown in providing for each sun wheel a fixed cylinder **72** in which is slidingly guided a piston **73** carrying outside the cylinder a head **74** provided with sets of claws adapted to be brought into engagement with complementary sets of claws **76** provided on the corresponding pinion **69** to **70**. The piston **73** is urged by a spring **77** tending to engage the head **74** with the claws **76** against the action on said piston of a fluid under pressure introduced into said cylinder through a pipe **78** from the oil circuit of the engine. Said piston **73** is further connected with the cylinder **72** by means of a torque limiting device **79**. When the engine is in operation the fluid pressure drives the piston **73** against the action of the spring **77** so that the corresponding pinion **69** or **70** may freely rotate. As soon as the oil pressure is lowered, the spring **77** shifts the piston **73**, whose head **74** engages the claws **76**, which stops the corresponding pinion **69** or **70** and, consequently, the sun wheel **63** or **64**, the differential gear thus forming a reducing gear with a ratio ½ between the running engine and the propellers. The torque limiting device **79** reduces the impact at stopping.

Fig. 4 shows also a way of carrying out the pitch variable control for the propellers by means of a single centrifugal governor in order that the speed of the engine may remain constant. This governor is driven by a pinion **81** connected with the various shafts by means of trains of gears **82**, **83**, with the interposition of one-way couplings **84** for insuring that the governor will be driven only from the engine running at the greatest speed, so that it will continue to be driven should one of the engines fail.

In the various embodiments above-described, the engines are shown inclined to the axis of the propellers and symmetrically arranged on each side of said axis. However, whatever which way the invention may otherwise have been carried out, these engines may also be arranged parallel to said propeller axis, as shown in Fig. 5, one of them being then located forward of the other and the transmission shaft from the most removed engine being divided into two parts connected by means of cardan joints of the like with a short shaft supported in an intermediate bearing **85**.

Obviously, the invention is in nowise limited to the details of the modifications shown and described, which are only indicated as examples.

Thus, instead of the various engines driving the same wheel keyed on one of the two propeller shafts which are connected together by a reversing gear, another wheel may be provided on the second propeller shaft, some of the engines driv-

ing the first of these wheels and the others the second.

On the other hand, instead of connecting the two propeller shafts by means of a reversing gear, these shafts may each carry a toothed wheel and these two wheels may be driven simultaneously by all the engines, the connection between the two wheels and each engine comprising for each wheel a supplementary reversing wheel if it is desired to have the two propeller shafts rotating in opposite directions.

Moreover, in the case of the modifications comprising variable speed gears, the latter may further comprise a special control adapted to be operated by the pilot without uncoupling the engine, such as on taking off, for example.

Likewise, the device for driving a single centrifugal which is shown in Fig. 4, may be applied to the embodiments of Figs. 2 and 3. This device shown in Fig. 4 with a single centrifugal governor may also be substituted with two governors as per Fig. 3, the electric reversing apparatus being then operated by the movement on one of the pistons 74. Lastly, in the three cases of Figs. 2, 3 and 4, in view of using only a single centrifugal governor, the latter may be of an adjustable type and adapted to be driven by any one of the propeller shafts.

CHARLES RAYMOND WASEIGE.

PUBLISHED C. R. WASEIGE Serial No.

JUNE 1, 1943. POLYENGINE BIPROPELLER GROUP FOR AERODYNES 450,935

BY A. P. C. Filed July 14, 1942 4 Sheets-Sheet 1

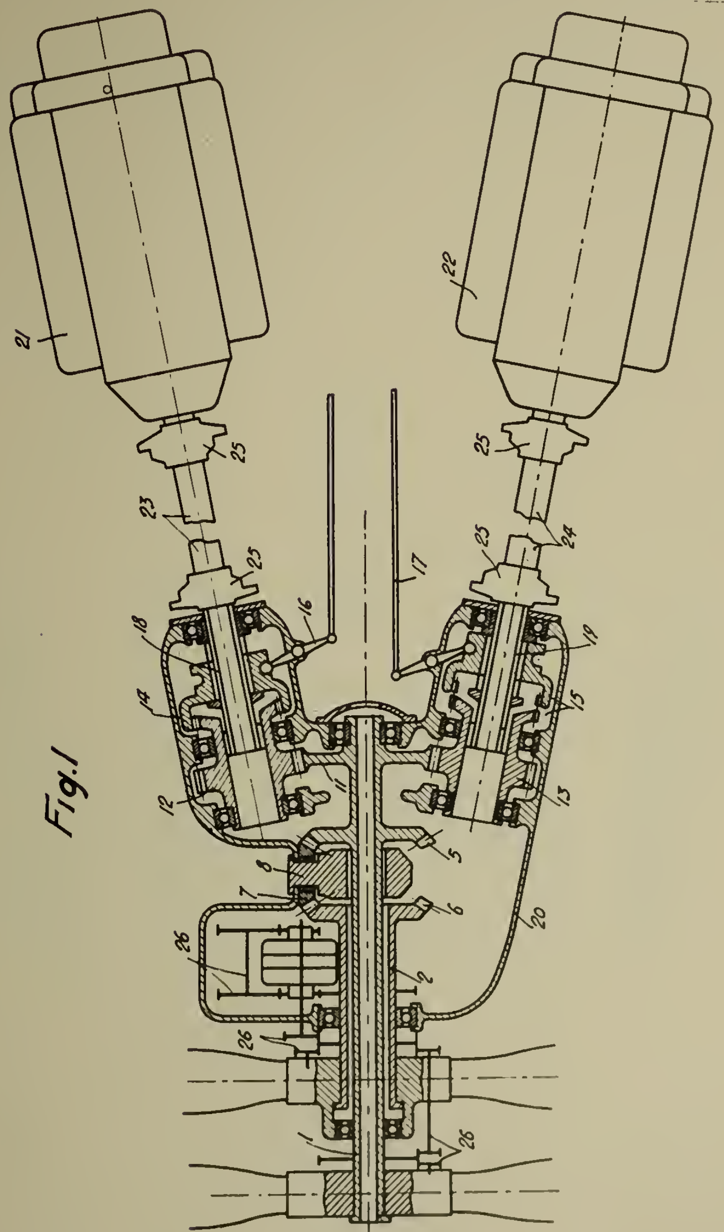

Fig. 1

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4 Sheets-Sheet 2

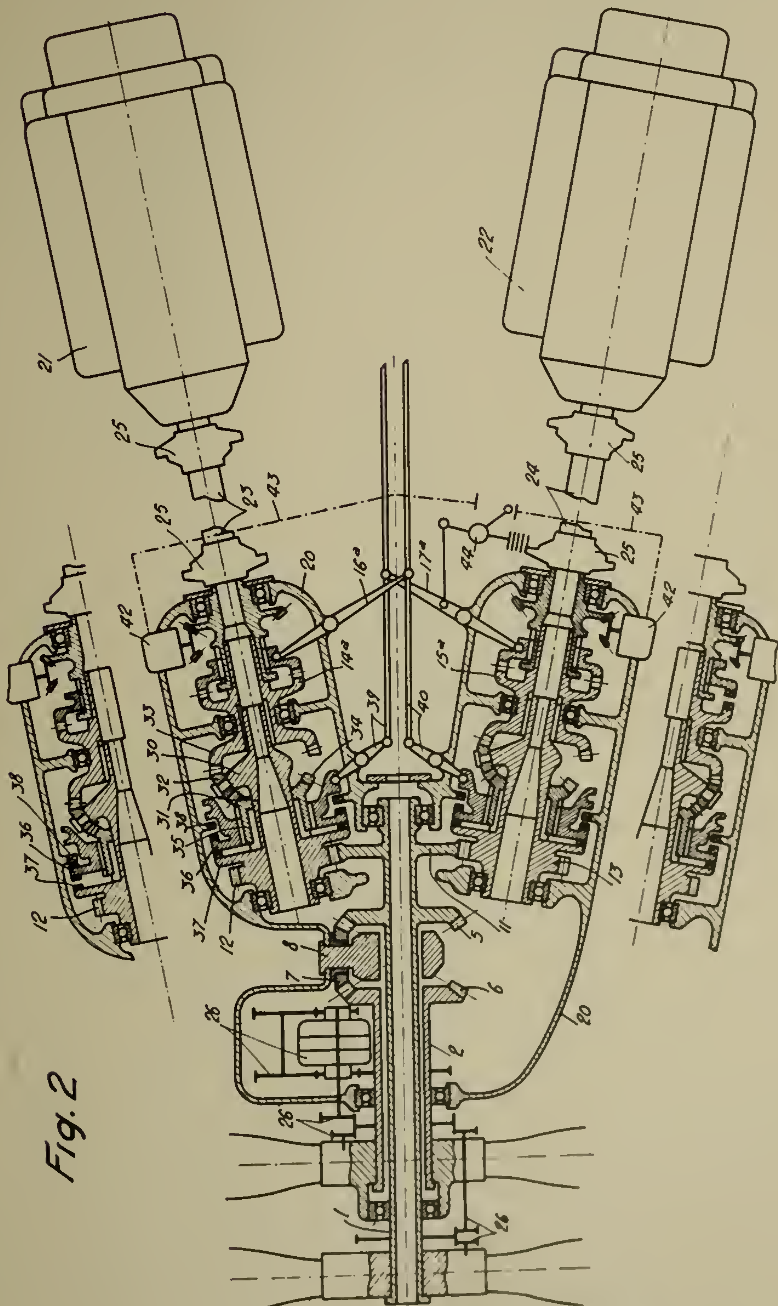

Fig. 2

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4 Sheets-Sheet 3

Fig. 5

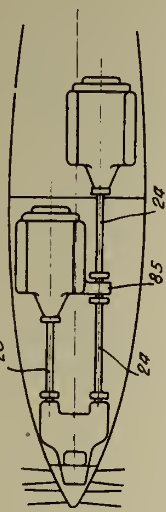
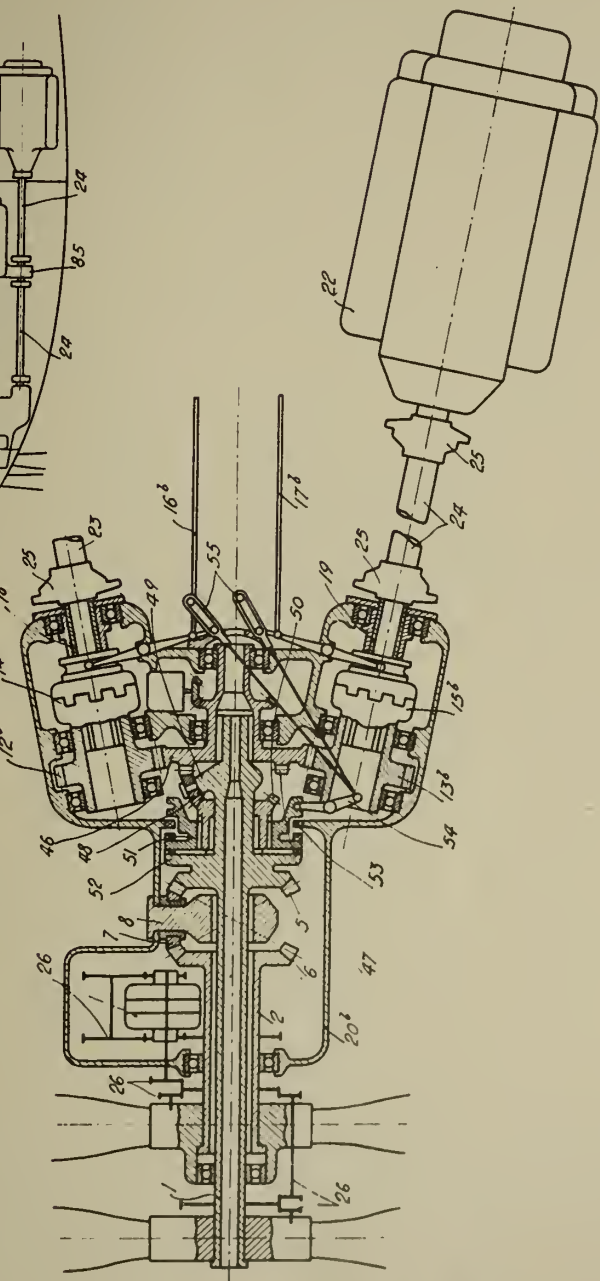


Fig. 3



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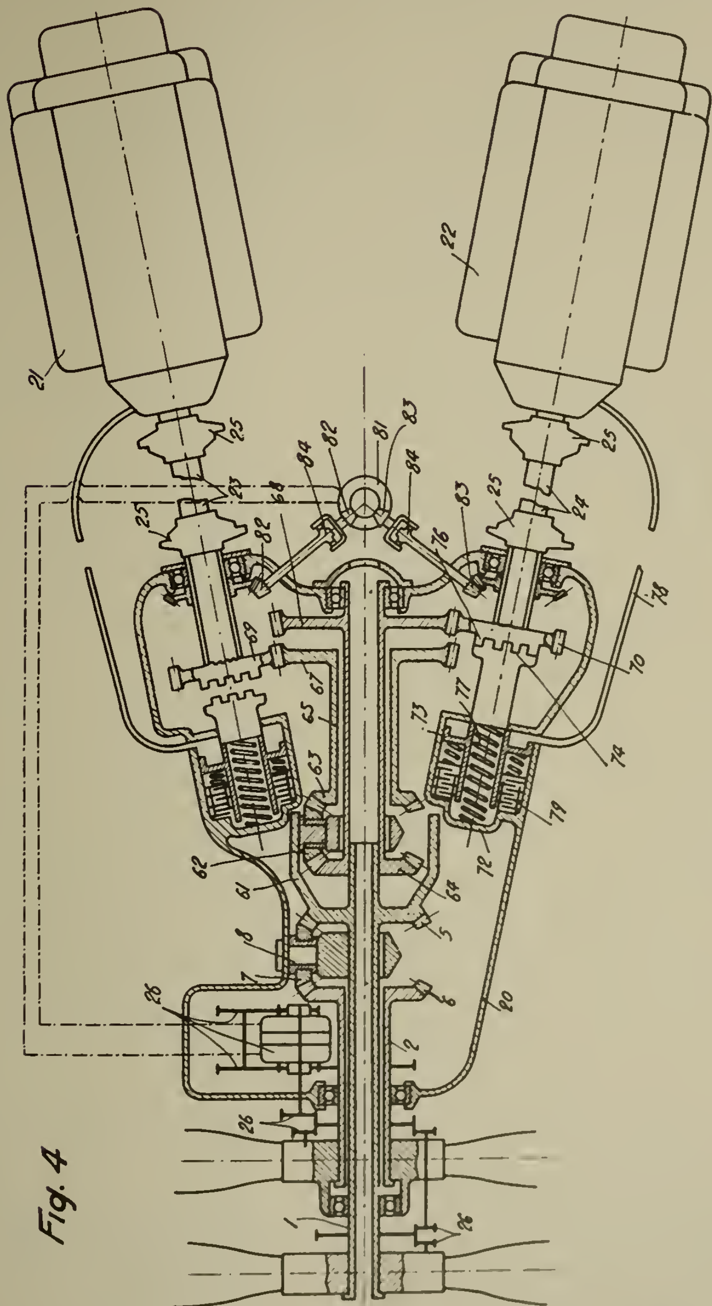

Fig. 4

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Published June 1, 1943 Serial No. 451,014

ALIEN PROPERTY CUSTODIAN

METHOD OF OBTAINING PERFECTLY CONSERVABLE INTEGRAL MEAL

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No Drawing. Application filed July 15, 1942

This invention relates to a new or improved method of processing cereal grains with a view to obtaining therefrom integral meal or flour capable of being perfectly conserved or kept without losing its properties.

For a proper understanding of the invention, it will be stated that an integral meal is one derived from the whole of the nutritive and non-replaceable elements to be found in cereal grains and particularly wheat grains in a state of intactness and accessibility to digesting juices as secreted by the human body.

It occurs that wheat grains naturally possess a remarkable constitution to the extent that when of good quality their composition approximates that connoting the average human food ration, as reckoned in carbon hydrates and albumins, which is the most properly balanced and most favorable one to human nourishment.

Moreover the biochemical science of cereal grains and the studies conducted to ascertain the relative importance of their several constituents have disclosed that the entire berries of wheat grains contain useful substances either of a mineral or of an organic nature which foster life while their lack is a cause of human decay. Such useful substances are generally present in the germ or embryo and protein layer, the latter forming a portion of the inner layers of the grain berry.

It follows from the foregoing that should bread be baked from integral meal, it could almost by itself sufficiently nourish the body to maintain life in the human diet.

However, the preparation of integral meal, as above defined, affords great difficulties so far as the milling operations and the biological peculiarities of certain parts of the grain berries, namely the germ or embryo and the protein under-covering are concerned. Such parts contain fatty and mineral substances and a number of diastases and vitamins that is to say substances which are highly sensitive to contamination by dirt and microbe impurities, also to the heat which is evolved during the process of milling.

As the present milling methods cannot overcome the aforesaid difficulties, the germ and protein underlayer of cereal grains have to be discarded and meal has to be produced almost exclusively from their central starchy portion which is deprived of those essential elements which in the process of nourishment are necessary to the maintenance of life. Consequently bread made from common meal or flour cannot fulfill a complete nourishing function for lack of essential feeding elements.

The impossibility of obtaining a so-called integral meal capable of being properly conserved for a long time by the present milling technique is mainly due to the two following reasons: Firstly, the impossibility of removing prior to the milling operations those dirts and microbe impurities which adhere to the grain berries namely to their outer surface and between the three cellulose coatings of the husk forming what is colloquially called the bran. Secondly the impossibility of conducting the milling operations under perfectly sanitary or thoroughly clean conditions.

The reason for this is that prior to being subjected to the action of milling appliances, cereal grains are in those processes as used heretofore cleaned externally only. Therefore while they are being milled, they still contain microbe sources intermediate their cellulose layers or coating (bran) and particularly in the nick or furrow of the grain berries since this hollow is fully inaccessible to cleaning means in all existing plants. As a result of this, there is inevitably caused during the first operative phases of the present disintegrating processes a microbe-containing dust which intermingles itself with the products of the milling operations. Besides, even meal as at present obtained only from the starchy portion of cereal grains does not lend itself to a prolonged conservation. Moreover should those portions of cereal grains that contain fatty substances and certain diastases, as is the case with the germ and protein underlying coating, be added to such a meal as produced heretofore, the meal even thus enriched would soon deteriorate and proper conservation of stocks thereof would prove impossible.

It follows from the foregoing considerations that milling operations as commonly performed at the present time are conducted in a non-sanitary ambiance which cannot ensure the removal of dirts and microbe impurities which are the sole causes of the deterioration or contamination of meal, particularly so-called integral meal, as was shown and demonstrated by scientific studies and experiments. The latter also revealed that integral meal as produced under optimum sanitary conditions can be kept as well and as long as starchy meal.

Furthermore, when endeavoring to produce integral meal by the present milling methods, the following difficulties are encountered, namely:

(a) Integral meal gives rise to bread having a

substantially darker color due to the presence of the seminal tegument layer containing a brown pigment and also to the presence of all kinds of microbe impurities which facilitate the development of noxious diastases during the fermentation of bread.

(b) Integral meal contains a larger percentage of coarsely milled cellulose, which curtails the development of bread.

The reasons for the set backs undergone in present milling methods when endeavoring to produce integral meal will now be better understood from the aforesaid explanations.

An object of the invention is to provide, as a new inventive process, an improved method each step of which is intended on the one hand to bring cereal grains to a proper state of cleanliness and, on the other hand, to keep them in said clean state throughout the whole set of preparatory and milling operations. Under the words "clean" and "cleanliness" should be understood not merely an absence of dirt, stains and micro-organic impurities but also, in a more general sense, the absence of any outer contaminating influence such as atmospheric moisture and such introductions of microbes as might spoil or deteriorate the cereal grains by depriving them of the required purity and might cause noxious reactions such as those which lead to rancidity, fermentation and like phenomena.

Another object of the invention is to provide a method of processing cereal grains whereby an integral meal or flour can be obtained which contains all nutritive and non-replaceable elements of wheat grains in a state of intactness and proper accessibility to the digestive juices secreted in the human body, said meal lending itself to a perfect and prolonged conservation and giving to bread baked therefrom good palatable qualities and a color and a development substantially analogous to those of bread made from common starchy meal.

With these and such other objects in view as will incidentally appear hereafter, the invention consists in the character, sequence and combination of specific steps constituting the improved method as set forth and pointed out in the appended claims.

In a suitable embodiment of the invention, the practical realization of the method may be as follows:

(A) Simultaneously with the customary step of removing or peeling off the bran layer from the previously moistened cereal grain so as to eliminate the pericarp, there is incorporated with the mass of grains which are being subjected to the treatment according to the invention a predetermined quantity of a granular material having abrading or attrition properties and a grain size definitely smaller than that of said cereal grains and possessing by itself a certain amount of roughness (advantageously and by way of example saw dust or an equivalent material) the purpose of which is, while penetrating into the nick or furrow of each grain berry, so detach therefrom whatever cellulose may have been left therein during said peeling step. This operation completes the cleaning of the grains while at the same time reducing the total quantity of cellulose which remains incorporated with the integral meal being produced.

(B) It should be borne in mind that the seminal tegument is made up of two layers or coatings of cells containing a brown pigment which, together with the hyaline band or strip, possess no nutritive value whatsoever. These two layers are inseparably connected with the protein layer and the three layers are known as the "welded and impervious layers." The removal of the seminal tegument and the hyaline band or the seminal tegument exclusively has so far never been carried out successfully. Now the brown pigment gives a peculiar color to the bread and, besides, the cellulose included in said two layers does not promote its development.

The removal of the layer of seminal tegument and of the hyaline band or only the seminal tegument is performed by an additional operation which comprises the step of imparting rotation to the mass of grains contained in a suitably shaped vessel. This follows the thorough cleansing operation carried out as set forth under (A) by means of a suitable quantity of a granular material having abrading or attrition properties and a grain size fairly smaller than that of the wheat grains, the inner wall of said vessel being also coated or otherwise provided with a lining of abrasive material.

This operation causes a very fine and regular polishing of the grain surface and consequently gives rise to a meal constituted by the seminal tegument and the hyaline band or the seminal tegument alone. By then subjecting the mixture of grains and granular abrasive material to the action of a separating or sifting device, segregation of both constituents may be obtained while a brushing action subsequent to the sifting removes the last traces of this meal.

(C) After having undergone the operation described under (A) and (B), the wheat grains then freed of the whole of the outer cellulose are thus in a state of perfect cleanliness.

However, there remains the liability that during the aforesaid treatments and the transfer of the grains from one device to another one, such grains may face microbe impurities. In order to obviate such a risk and to subject to the milling operations perfectly that is to say aseptically clean grains, these are transferred to the mall through a sterilizer such for example as an ozonizer.

(D) Following this treatment, the grains may be considered as being perfectly clean and aseptized and ready to be subjected to the milling operations. Such a state of cleanliness must now be preserved and said operations should also take place under perfectly clean conditions.

In order to fulfill this requirement, it is essential that the worker should neither manipulate or handle the wheat grains proper, nor the meal ground therefrom since it must remain perfectly clean for the aforesaid reasons. Consequently the milling operations must be entirely automatic without requiring either manual adjustment or supervision, nor the intervention of labor.

The grains brought to the mill include all the initial grains freed from the three layers or coatings of outer cellulose, seminal tegument and hyaline band or strip or else seminal tegument only. It will be seen therefore that the grains include substantially the whole of the nutritive and non-replaceable components that are naturally incorporated with the wheat.

As above stated, a number of non-replaceable substances are to be found in the cells of the protein underlayer. These are not attackable by the digesting juices. It is accordingly necessary to mechanically open them up. However, the apparatus as used in present milling plants

cannot achieve this result without damaging the cereal grains. Such substances must be therefore ground by other means which particularly involve abrading processes.

It is a well known fact that the contents of the protein underlayer include fatty substances and a range of diastases (for example tyrosine) which are highly sensitive to moistness and above all to microbe influences. Under certain conditions, such substances become oxidized and impart to the meal and particularly to the bread made from it a dark color while being liable to produce noxious fermentations.

In order to remedy these disadvantages, the milling operation which involves an abrading process as well as the transfer and evacuation of the resultant meal should be carried out in an atmosphere formed of an inert and nontoxious gas such for example as carbon dioxide.

This result which is totally unattainable under present milling conditions cannot be obtained except if the milling operations are absolutely automatic and require neither the intervention of labor, nor any supervision involving manual handling by the operator and also if the milling plant proper is completely separate from the other appliances comprised in the mill.

VOLDEMAR BORSAKOVSKY.

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ALIEN PROPERTY CUSTODIAN

CHANGE SPEED MECHANISM

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Application filed July 16, 1942

As is known, numerous change speed gears are based on the general principle of transmitting motion from a driving shaft to a driven shaft by means of a plurality of units each of which comprises a pair of cranks interconnected by a pitman, one of said cranks having a constant throw and being connected to the driven shaft by means of a free wheel clutch adapted to impart motion to said shaft in one direction of rotation only, while the other crank is fast upon the driving shaft and has an adjustable length or throw. Owing to this construction, it will be understood that by multiplying the number of driving cranks and driven cranks and by suitably arranging them around their respective axes, the possibility is afforded of converting into a continuous movement the series of elementary impulses received by the driven shaft and of rendering its speed sufficiently uniform, while by adjusting the throw of the cranks mounted on the driving shaft the amplitude of such elementary impulses imparted to the driven shaft and consequently its speed of revolution may be varied, said speed being brought down to zero value when the throw of said cranks is reduced to such value by causing the pitman ends to coincide with the driving axis.

Known gears based on the aforesaid principle show three principal disadvantages: A first disadvantage is the practical difficulty of providing a sufficiently simple and rugged free wheel clutch for use as above stated. A second disadvantage is the difficulty of providing for a variation of the throws of driving cranks during operation by simple and reliable means. A third disadvantage is the difficulty of suitably distributing the operative action of the several driving cranks so as to obtain a regular torque.

An object of the present invention is to provide a new change speed mechanism of improved construction obviating the aforesaid disadvantages and constituting a better construction for carrying into practice the above-cited general principle.

Another object of the invention is to provide an improved change speed mechanism comprising a plurality of free wheel clutches including differentials involving frictional bands or strips of flexible nature cooperating with impulse transmitters so as to properly select impulses to be transmitted.

A further object of the invention is to provide a change speed mechanism of such an improved structure that variation of the throws of the primary or driving cranks is performed by means of slider devices carried in crank disks and actuated through the medium of planet gears.

A still further object of the invention is to provide a change speed mechanism having such an improved structure that its movement is regularized by interconnecting the several driven shafts by suitably arranged toothed pinions and pivoted links.

With these and such other objects in view as will incidentally appear hereafter, the invention comprises the novel construction, combination and arrangement of parts that will now be described with reference to the accompanying diagrammatic drawings exemplifying the same and forming a part of the present disclosure.

In the drawings:

Figure 1 is a diagrammatic illustration showing the kinetic principle on which is based the operation of the improved mechanism according to the invention.

Figure 2 is a view of a constructional embodiment of the clutch comprised in said mechanism and associated with the driven shaft.

Figure 3 is a view similar to Fig. 2 showing a modification of this clutch.

Figure 4 is a plan view showing the device for varying the throw of the primary cranks comprised in the new mechanism.

Figure 5 is an elevational view showing the way in which the several primary cranks may be arranged with respect to one another.

Reference being first had to Fig. 1, O designates the geometrical axis of a driving shaft, and O' the geometrical axis of a driven shaft which it is required to connect up to said driving shaft through a change speed mechanism of the crank and pitman type. A primary crank OM is mounted on the driving shaft, and a secondary crank O'M' (of greater length than the primary crank OM) is mounted fast on the driven shaft. These two cranks are interconnected by a pitman MM' so that to one complete revolution of the driving shaft correspond two equal and oppositely directed oscillations of the crank O'M'. Assuming the driving connection between the crank O'M' and its shaft O' to be in the form of a free wheel clutch adapted to impart the drive in one direction of rotation only (as shown by the arrows *a* in Figs. 2 and 3) it will be understood that a continuous motion of the driving shaft O will impart a series of impulses to the driven shaft O' in the direction permitted by said free wheel clutch.

Owing to this arrangement, it will do to sufficiently multiply the number of driving and driven

cranks and to suitably distribute them around their respective axes to cause the motion of the driven shaft to become continuous and to ensure substantial uniformity of its speed.

It will be also understood that assuming the throw of the driven crank O'M' to remain invariable, where the throw of the driving crank OM is varied, the extent of the elementary impulses imparted to the driven shaft O' will be more and more reduced and the substantially continuous rotational speed which will ensue will be slower and slower. It will even fall to zero if the crank throw OM is itself reduced to zero.

Therefore, assuming the driving shaft O to revolve at a uniform speed, the possibility is afforded to transmit a varying speed to the shaft O' by a mere variation of the throw or throws of the driving crank or cranks such as OM.

In order to obviate the disadvantages of the several change speed gears based on the aforesaid operative principle, the following arrangements of parts have been devised according to the invention.

Free wheel clutch (Figs. 2 and 3)

The actuation of the driven shaft is performed not by ratchet wheels, pawls, balls and wedges but by a flexible ring constituting a band clutch whose operation corresponds with the one of so-called differential band brakes the characteristic feature of which is to become tightened or applied in a predetermined rotational direction and untightened or released in the opposite direction.

As shown in Fig. 2 a cup-shaped transmitter member 1 is freely centered on the driven shaft O' and has an apertured lug 1^a on its periphery for connection to the pitman MM'. As the driving shaft O rotates clockwise, the pitman MM' is reciprocated so that its end M' assumes the position shown in dotted lines and then resumes its rear position. Against the inner rim of this cup-shaped member 1 is applied over approximately two thirds of its circumference a ring segment 2 made of a steel strip endowed with qualities of strength and flexibility. The ring segment 2 is provided on its surface contacting the impulse transmitter member 1 with a friction lining 3. The ring segment 2 constitutes the driven ring element and is connected at both ends to toggle levers 4, 5 hinged to a sleeve 6 firmly girdling the driven shaft O'.

As is known, when a drive of this category comprises as above described a flexible tie, the tensions T and t which prevail at both ends during the operation are in the following ratio:

$$\frac{T}{t}=e^{f\theta}$$

wherein f is the coefficient of friction of the interposed lining, θ is the angle corresponding to the portion of the circumference on which said lining bears, and e is the base of Neper logarithms.

Where three quarters of the circumference are encompassed by the lining and the latter is of medium type, the ratio may be

$$\frac{T}{t}=4$$

As is also known, the tangential stress which provides frictional drive is equal to the difference of both tensions, namely $T-t$ so that, in the present instance, $F=3t$.

Therefore, assuming the flexible ring segment 2 to be applied as usual against the cup-shaped member 1 and to bear on it with a very weak preliminary force, as soon as said member 1 is actuated in the required direction, each end of the ring segment 2 transmits to the lever which carries it a tension of such magnitude that one of them is four times as large as the other.

By interconnecting the levers 4, 5 by means of a coupling link 7, the effect of these two tensions can be carried from one upon the other. As a result of this, assuming for example a small tension to be initiated at one end, a more or less large portion of the tension T which is set up at the opposite end may be carried over to the tension t which will thus grow to become t', thereby giving rise to a tension T' which will also be larger, and so forth until proper driving force is obtained.

For a reverse drive, it will be understood from analogous reasons that full release is also automatic.

Depending upon the position of the hinges which pivotally connect the link 7 to the levers 4, 5, a possibility is obtained of varying the ratio in which the tensions T and t react upon each other.

An absolutely immediate drive is thus secured which, besides not being violent, is devoid of jerks and rattle.

In practical construction, the number of hinges or pivotal joints should be minimized. Thus, for example, both ends of the ring segment 2 may be interconnected as shown in Fig. 3. In this constructional form, the hinges of the ring segment to the levers are replaced by a direct fastening of the flexible strip forming said segment 2 to the levers 4' and 5' and the inherent flexibility of the strip permits, for those very small oscillations which are necessary, relative motions between the ring segment and the levers. Moreover, these levers have a particular shape which enables them to be interconnected by a mere contact. These shapes are not, however, limitative. The cup-shaped member might be pulled back by a return spring. Thus changes in the contacting point of the trunnions are avoided when the direction of operation is inverted.

Crank throw varying device

A device for varying crank throw is illustrated in Figs. 4 and 5. The shaft 8 is assumed to be driven from a motor, engine or other prime mover and actuates through the medium of a set of gears the shaft which carries the crank pins or trunnions, said shaft to be hereafter referred to, for the sake of clearness, as the "driving shaft". This shaft is made up of two parts or stub shafts 9, 10 each of which receives the motion from the shaft 8 through a double bevel gear 8^a, 8^b so that said stub shafts 9, 10 rotate at equal speeds but in opposite directions.

Each stub part of the driving shaft is provided at its other end with a crank disk 11 whose crank pin 12 is connected to a runner or slider 13 which can be moved diametrically in a dovetail runway 13' formed in the crank disk 11 so that the crank pin can be brought to the center of said disk.

The slider which carries the pin 12 is provided with a nut 14 actuated by a screwed rod 15 the rotation of which can shift said slider 13 longitudinally in the disk 11. Rotation of the screwed rod 15 is performed by a bevel gear formed of a pair of bevel pinions. One of these pinions designated by 16 is integral with the rod 15 while the other pinion 17 is connected to one end of a spindle 18 revolubly housed in an axial bore of the stub shaft and fitted at its other end with a bevel pinion 19. Therefore both bevel pinions 19 and their carrying spindles rotate normally at equal speeds but in opposite directions. These

two bevel pinions **19** are the sun elements of a planetary differential system made up of the pinions **19**, planet pinions **20** and planet pinion carrier **21** the outer periphery of which has skew teeth to form a worm wheel.

Normally the worm wheel **21** forming a planet gear carrier is motionless since the pinions **19** rotate at equal speeds but in opposite directions. Said carrier is furthermore held stationary by a cooperating worm **22** which may be driven in the one or the other direction, for example manually by means of an actuator such as a hand wheel **22'** or by any equivalent manually or mechanically controlled contrivance.

In view of this construction, as long as the planet gear carrier **21** remains stationary, the bevel pinions **19** rotate at a speed equal to that of the driving shaft so that no motion is produced which might shift the crank pins **12** and alter the primary crank throw. However, any rotation of the planet gear carrier **21** in either direction brings about a variation of speed of the pinions **19** and consequently a relative movement with respect to the driving shafts. This causes a rotation of the spindles **18** of the pinions **17**, **16**, of the screwed rod **15** and therefore a displacement of the nut **14** and crank pin **12**, i. e. an alteration of the primary crank throw.

It will be seen that variation of the crank throw is consequently obtained by a very accurate and easily operable drive either directly as shown or by means of any servo motor (not shown) of conventional structure.

Distribution of the action of the secondary cranks

The showing of fig. 5 makes it quite clear how the action of the secondary cranks can be so used as to cause the rotation of the driven shaft to be sufficiently continuous and uniform. In this figure is shown one of the crank disks **11** which may be considered, for the sake of convenience, as the left hand crank disk. This disk revolves clockwise and drives during a partial revolution the driven shaft **23** which carries the free wheel clutch described above with reference to fig. 3.

However, this partial revolution is carried over to a third shaft **24** by a set of intermeshing equal gears **25**. Therefore, whenever the crank disk **11** effects half a revolution, the shaft **24** effects a partial revolution counter-clockwise.

As will be understood, however, for the second half revolution of the crank disk, the action of the pitman **26** which, owing to the provision of the free wheel clutch, remains without any effect upon the shaft **23** during the return motion of said pitman is carried over to the shaft **24** owing to the presence of a coupling link **27** which controls a free wheel clutch similar to the clutch mounted on the shaft **23** but operating in a reverse direction.

Consequently the shaft **24** is imparted a second impulse counter-clockwise. This impulse immediately follows the first one. A full revolution of the crank disk **11** imparts two impulses in the same direction to the shaft **24**.

The right hand crank disk (not visible in fig. 5) operates in a similar way but in such a manner that the impulses imparted thereby to the shaft **24** should be combined in the most suitable way with the first two impulses so as to regularize the motion. This result is obtained by suitably offsetting the right hand crank pin with respect to the left hand crank pin and by correspondingly arranging the operating pitmans. As a result of this, four impulses are obtained at each revolution of the driving shaft. Any such slight speed variations as may subsist are made good by the inherent inertia of the gear or by fitting the same with a fly wheel.

The differential gear for operating the crank pins is shown in a simplified embodiment in fig. 4 so as to do away with superfluous descriptive matter. However, it will be understood that this embodiment is only diagrammatic and that many constructional variations may be introduced particularly by using sun and planet spur gears. Likewise, the crank pins might be replaced in numerous instances by eccenters, whereby the shaft carrying them could be directly actuated by being merely coupled up with the driving shaft. Such a constructional form would enable the number of impulses to be multiplied and such impulses to be transmitted by single acting cranks.

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PUBLISHED
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BY A. P. C.

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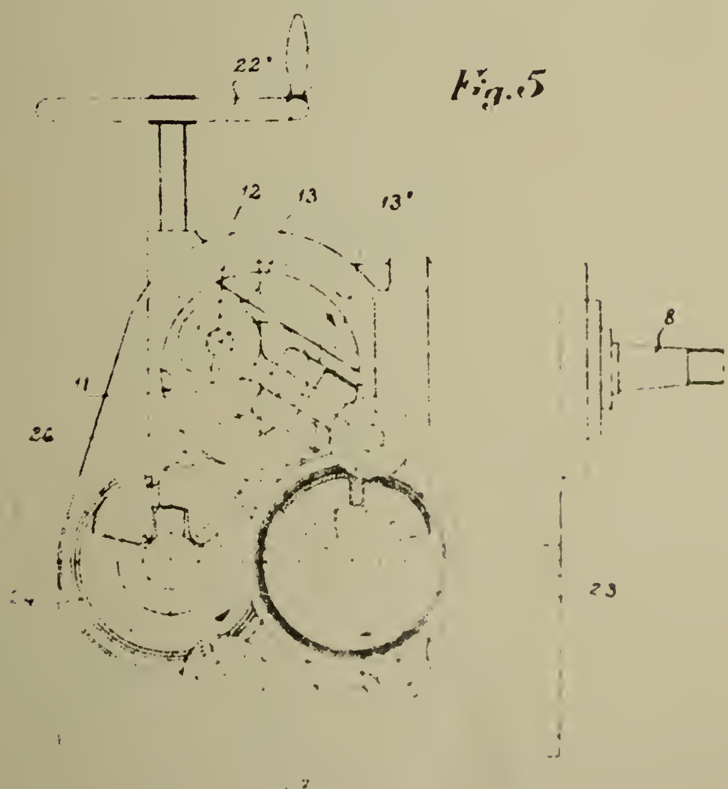
2 Sheets-Sheet 1

Fig. 1

Fig. 5



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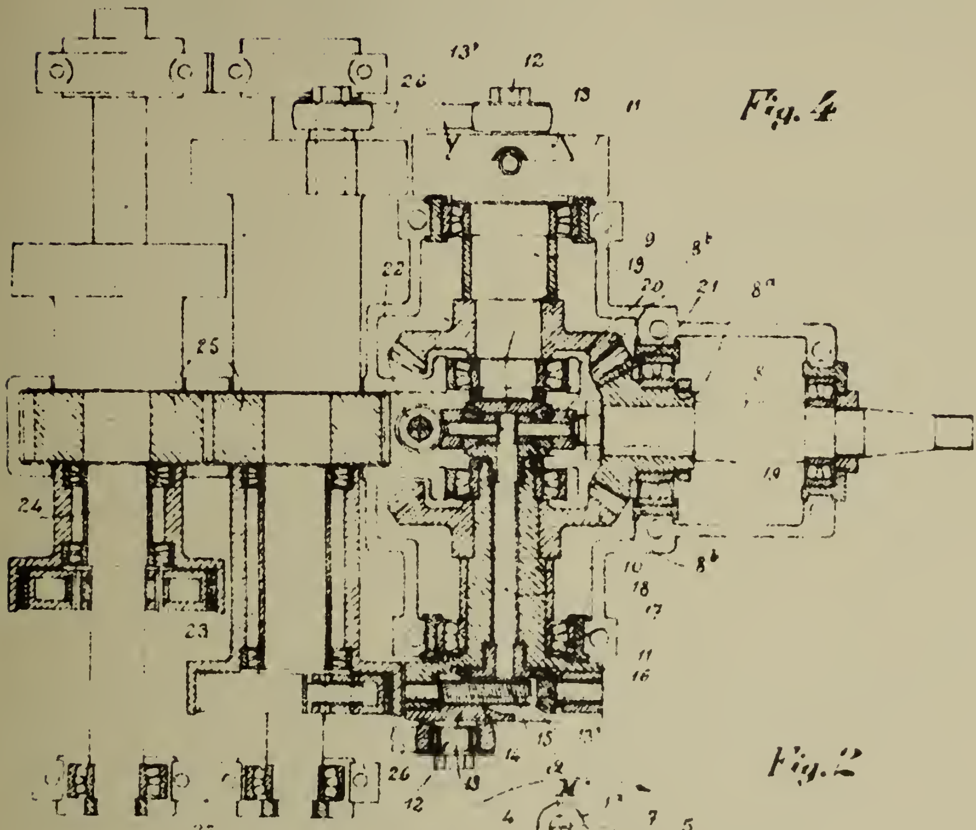


Fig. 4

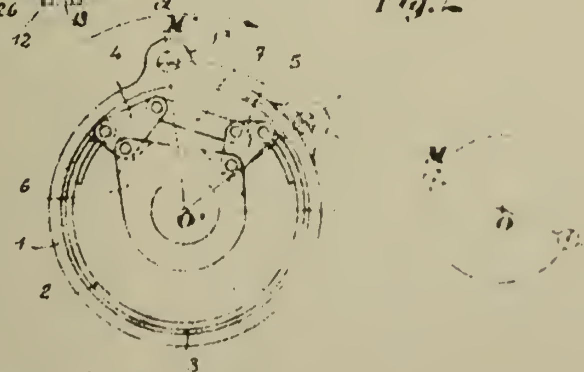
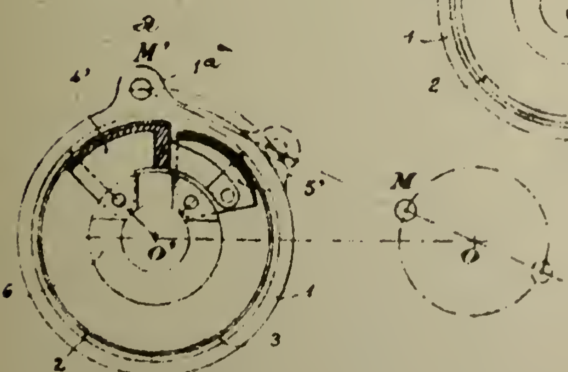


Fig. 2

Fig. 3



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ALIEN PROPERTY CUSTODIAN

CENTRIFUGAL CASTINGS

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Application filed August 5, 1942

The present invention relates to the casting by centrifugation into rotary moulds, of hollow members such as tubes or pipes.

The long and thin tubes used up to the present are generally obtained by distorting solid ingots, in the cold state, or more often in the hot state. Very numerous processes are known for effecting said distortions. All said processes have serious inconveniences: they are complicated, necessitate powerful plants, comprise successive steps requiring a considerable amount of labour and involving a very high consumption of energy. Moreover, they sometimes necessitate successfully reheating the metal several times, and the products thus obtained do not escape all the difficulties of manufacture and all the imperfections of execution inherent to rolling. In particular, the presence of solder can limit the conditions of use of certain welded tubes.

Finally, all these tubes can only be obtained in well defined shades of metal. For instance, in the case of steel, certain shades of steel may happen to be set aside, whatever may be the advantages they might offer, either because they are industrially unsuitable for rolling, or because they cannot be welded, or because they have an important shrinkage and that they are apt to present shrinkage holes, or for any other similar reason.

One the other hand, it is known that the casting of similar members, of very great length and reduced cross-section or of small thickness, has encountered very great difficulties as regards numerous materials and several metals. In particular, the casting by centrifugation of long and thin tubular members has only been solved up to now for certain metals or alloys relatively easy to melt and having great fluidity.

It has not been possible for instance to use centrifugal casting methods consisting in successively injecting the molten metal at each point of the rotating mould by means of a casting conduit moving longitudinally within said mould, for metals or alloys which are difficult to melt: in fact, the important and unavoidable cooling of said metals along the casting conduit would necessitate, in order that they should reach the mould at a sufficient temperature, a too important superheating which would involve difficulties in the melting, transport, oxidation or the like, of said metals.

On the other hand, the processes consisting in massively casting these same metals into a rotating mould are also inapplicable: in fact, the rapid solidification of said metals would not leave them the time to become distributed, along the mould, in the form of a uniform layer, especially if long and thin members are to be produced.

The present invention has for object a new centrifugal casting method allowing to obtain pipes or other long and thin tubular members, which can be applied to all metals, alloys or other fusible materials, even to those which are difficult to raise to a temperature much higher than their melting temperature, and which owing to their low fluidity reserve, do not lend themselves, industrially, to casting by the known methods.

Another object of the invention is to provide rotating devices for carrying out the process according to the invention and allowing the manufacture of cast articles of substantially tubular shape in very varied metals and in particular in steel.

The other objects of the invention will become apparent from the following description.

The method according to the present invention consists in progressively casting the molten metal at one end of the rotating mould, by injecting it into said mould through one of its end walls, in choosing and controlling the speed of injection and the speed of rotation of the mould in function of the temperature and of the physical characteristics of the metal, of those of the mould as well as the dimensions of the member to be manufactured, so as to determine the rapid solidification of the successive portions of said metal by contact with the walls of the mould, the entire period of casting being thus much longer than the time necessary for the solidification of each of the portions of said metal.

In the casting method according to the invention, the consecutive cooling, solidification and localization of the metal therefore begin from the inlet end of the mould (side where the casting is effected) and then proceed towards the opposite end, the molten metal injected at every instant proceeding, without appreciably cooling, at the internal surface of the metal previously injected, already solidified, but still very hot, until it reaches the free part of the mould and by contact with which it cools and solidifies in its turn.

The surface separating the molten metal and the solidified metal thus moves towards the end of the mould, without distorting, and assuming at every instant a flared shape which promotes the advance of the molten metal, as will be set forth hereinafter.

According to other features of the invention and for facilitating the advance of the molten metal within the mould, after its injection into

the later, forces are exerted thereon having a longitudinal component directed towards the end of the mould, or, when it is injected into the mould, an initial impulse is imparted thereto directed in the same direction, or both the above mentioned forces and impulse are exerted thereon.

According to another feature of the invention, use is made of a mould closed at its end and comprising at its inlet end an orifice of reduced dimension, allowing solely the injection of the metal and the evacuation of the gases contained in the mould or dissolved in the metal, so as to prevent the entrance of ambient air, the internal cooling of the member and the formation, in the midst of the latter, of a solidification surface proceeding from the interior towards the exterior.

Such a rotating mould, metallic or not, comprises means for exerting on the molten metal to be cast after its injection into the mould, forces the longitudinal resultant of which is directed towards the end of the mould opposite the casting end, or for imparting thereto, when it is injected, an impulse directed in the same direction.

Said means can be constituted for instance, by a mould having a diverging profile or by a mould having an axis inclined relatively to the horizontal, or again by a distributor comprising a container for molten metal and a calibrated nozzle under pressure opening in alignment with the orifice of the mould, or also by a rotating divergent distributor placed in front of the mould, or finally by the combination of several of the above mentioned means.

Other features and advantages of the present invention will be set forth in the following description.

In the accompanying drawings given by way of example only:

Fig. 1 is a longitudinal section of a centrifugal casting device according to the invention, illustrated at the beginning of the casting;

Fig. 2 is a cross-section of said device, made according to line 2—2 of Fig. 1.

Fig. 3 is a diagrammatic view, on an enlarged scale, in longitudinal section of the same device, showing the flared shape of the surface separating the molten metal and the solidified metal, as well as the propelling action exerted by said surface, by its rotation, on the molten metal.

Fig. 4 is a view in longitudinal section, at the end of the casting, of the device illustrated in Figs. 1 and 2.

Fig. 5 is a view in longitudinal section of a modification comprising the use of an inclined cylindrical mould.

Fig. 6 shows a longitudinal section of another embodiment of the invention comprising the use of a truncated mould exerting an increased propelling action on the molten metal.

Fig. 7 is a partial diagrammatic view, in longitudinal section, of a modification of the casting device comprising the use of a divergent distributing injector intended to increase the initial speed of the metal or other molten material when it is injected in the mould, this plant being illustrated at the beginning of the casting.

Fig. 8 is a cross sectional view of a different form of distributor.

Fig. 9 is a longitudinal section of another modification of the casting device in which the member to be cast itself constitutes a divergent distributor.

Fig. 10 is a longitudinal section of a cylindrical pipe.

Figs. 11 and 12 illustrate by way of examples, a tubular article capable of being manufactured according to the invention.

According to the examples illustrated in Figs. 1 to 4, the plant for centrifugal casting according to the invention comprises a rotating mould 1 (Fig. 1) movable about a horizontal axis X—X. The mould is supported and rotatably driven by rollers 2 and 3 rotating about axes Y—Y, and capable of being rotatably driven in their turn by a driving device, not shown. The mould 1 is held stationary longitudinally by external flanges 4 which take a bearing laterally on the rollers 3.

The body of the mould is constituted by a metal frame 5 provided with a refractory lining 6 made of moulding sand compressed and stoved; holes 7 are formed through the frame 5 to allow the evacuation of the gases produced in the refractory lining at the time of casting.

The frame 5 is terminated at its ends by truncated bearings 8 and 9 on which are secured, by means of keys 10, the end walls of the mould; said end walls are themselves constituted by a metallic cup 11 which supports a refractory lining 12; one of the end walls is provided with a central orifice 13 for the injection of the molten metal.

This injection orifice opens in alignment with a nozzle 14 arranged at the bottom of a casting pot 15, said nozzle and its casting pot being constituted by a pisé or any other refractory material.

The casting, according to the method of the invention, is effected in the following manner: the mould 1 is set in rotation and the molten metal 16 is rapidly poured into the casting pot; the metal escapes through the nozzle 14 in the form of a jet 17 with a speed which is dependent on the height of metal above said nozzle; at the same time, the casting pot 15 continues to be fed so as to maintain constant the level of the metal and, consequently, the flow from the nozzle.

The metal enters the mould 1 and comes into contact with the internal wall 18 of the latter in the very vicinity of the inlet end of the mould. It is drawn along in the rotary movement of the mould and it is applied by centrifugal force against the internal surface 18.

The layer of metal 19 (Fig. 3) being for a moment the most forward in the mould 1 and encountering no obstacle to its flow at the front, continually tends under the action of centrifugal force, to spread out on a certain length AB and take the shape of a ring, the inner radius DE of which increases from the rear A towards the front B, thus constituting a tubular element the free inner surface 20 of which is flared towards the front. As said advanced molten layer of decreasing thickness becomes localized by the very contact of the cold or relatively cold mould, it solidifies and rapidly comes to rest in this position thus affording for the following molten layer 21 a solid truncated casing.

Each particle P of the layer 21 is thus subjected to a centrifugal force PC at right angles to the axis X—X. If the mass of the particle P is designated by m, its distance PH to the axis X—X by r and the angular speed of rotation of the mould by ω, the value of the centrifugal force is given by the known formula:

$$PC=m\omega^2\cdot r$$

This force can be decomposed into its two

components: PN at right angles to the solidification surface of the ring and which applies the metal against said surface, and PL parallel to the meridian to said surface. The latter causes the metal to move towards the free part of the mould where it solidifies in its turn in the same conditions and in the same shape as the metal of the preceding layer, as it is intended in its turn to play the same useful transitory part for the benefit of the following layer.

The phenomenon thus finds very advantageously in itself the means of sustaining its own evolution according to a stable and lasting regime, as the molten layers which thus propagate forwardly constantly leave place behind them for the molten metal which continually penetrates into the mould during the casting operation.

Said metal thus proceeds (Fig. 4) in the form of a liquid cylinder **22** within the solid cylinder **23** formed by the metal already set. This solid cylinder is still very hot and, by contact therewith, the portions of molten metal successively injected practically maintain their temperature, they remain fluid, thus flowing through a metal tube the length of which progressively increases, and successively come into contact with the free internal and cold wall **18** of the mould against which they solidify in their turn.

Consequently, the placing in position of the metal proceeds step by step practically indefinitely. This phenomenon ceases only when the casting is stopped or when the advancing metal encounters the end wall **24** of the mould. The injection of the metal must have ceased at this precise moment as the casting is then normally terminated. It then suffices to remove the cast member from its mould.

According to an important feature of the method of the invention, the layer of metal solidified at each point rapidly reaches a thickness approximating the final desired thickness; the circulation of the molten metal within the metal cylinder already solidified prevents the latter from cooling and its thickness from increasing appreciably during all the casting period. The solidification therefore takes place as a whole, according to a longitudinal process.

On the contrary, in the known processes, said solidification takes place, in particular after the molten metal has been distributed on the entire length or on an important part of the length of the mould; the thickness of the solidified metal increases simultaneously at each point and the solidification thus takes place, as a whole, according to a radial process.

The final thickness of the tubes cast according to the method of the present invention depends on numerous factors and, in the first place, on the cooling action of the mould.

It may be noted that, all things being moreover equal, the layer of solidified metal is so much the thinner:

as the mould has a smaller thermal conductivity,
as it is hotter,
as it is thinner,
as it has a lower specific heat and
as, consequently, it heats up more rapidly.

For instance, the thickness of the solidified metal is greater in an entirely metallic mould than in a mould lined with refractory material.

On the other hand, the features and physical state of the cast metal also intervene in the solidification process, the solidified layer being so much the thinner,

as the metal has a higher specific heat,
as it is hotter and of a more fluid nature.

Finally, the thickness of the solidified metal depends, to a certain extent, on the duration of the casting, conditioned in its turn to the outflow of the nozzle; a more rapid casting limits the quantity of heat yielded to the mould by the metal, and consequently, the thickness of the solidified layer.

In any case, an important feature of the invention resides in the combined use of a mould having definite thermal characteristics and for instance uniform throughout its length, and a calibrated nozzle, or other device distributing the molten metal at a constant flow, in order to maintain constant, throughout the length of the mould, the thermal conditions of the solidification and to thus obtain members of uniform thickness.

When the mould is very long, the temperature of the molten metal may slightly diminish from the inlet end to the end of the mould and the conditions of solidification be slightly modified thereby. But, in this case, it remains possible to maintain the thickness of the members uniform throughout their length by varying the flow during casting or by varying the thermal characteristics of the mould, for instance, its thickness at various distances from its inlet end.

More generally, the invention allows of obtaining at every point the desired thickness of metal by simultaneously controlling the flow of metal at every instant of the casting and the thermal characteristics at every point of the mould.

Owing to the new manner in which the molten metal is distributed in the mould without its temperature and its fluidity diminishing appreciably, and to the possibility of acting on the various above mentioned factors, the invention allows said metal to be injected at a very great distance from the casting orifice and to thus obtain thin and long tubular members even with metals which it is very difficult and expensive to raise to a temperature higher than the melting temperature, which therefore have only a small temperature margin and the fluidity of which diminishes very rapidly as soon as their temperature lowers approximately to melting temperature.

According to the particular example of Fig. 10, the steel tube, cast by centrifugation according to the invention, is a long and thin tube for pipelines. Its outer surface and its inner surface can be cylindrical and concentric or conical and can comprise bosses, flutes, grooves, etc., as well as the members for assembling them and fitting them together.

The length l of said tubes can reach for instance 6 or 8 meters or even more. Their internal diameter d can vary for instance from a few centimeters, 2 cm. for instance, to several decimeters, and even if need be exceed one meter.

The thickness e of the walls of said tubes, which varies in function of the diameter, of the pressure of the fluid it is intended to transport and of various other factors, can lower to 4 or 5 and even to 2 millimeters or reach, for instance 15 to 20 millimeters for tubes of medium or of large diameter subjected to an important internal pressure or external stresses. For steel tubes the length of which exceeds one meter, it is possible to obtain, owing to the means of the invention, a

wall thickness lower than 1% and even than 0.5% of the length, which is impossible with known casting processes.

Fig. 5 shows the same tube in course of manufacture by centrifugal casting in a rotating mould movable about an axis X—X inclined relatively to the horizontal. The mould is constituted by a metallic frame **5** internally provided with a refractory lining **6** made of moulding sand compressed and stoved, holes **7** being formed through the frame **5** for allowing the evacuation of the gases produced in the refractory lining at the time of casting. The frame **5** is terminated at its ends by truncated bearings **8** and **9** on which are secured, by means of keys **10**, two end walls constituted by a metallic cup **11** which supports a refractory lining **12**; the highest end wall has a central orifice **13** for the injection of the molten metal. This injection orifice opens in alignment with a nozzle **14** arranged at the bottom of a casting pot **15**; said nozzle and its casting pot are constituted by a pisé or any other refractory material.

The mould is supported and rotatably driven by rollers **16a** and **17a** rotating about axes Y—Y, and rotatably driven in their turn by a driving device, not shown. The mould 1 is held stationary longitudinally by outer flanges **18a** which take a bearing laterally on the rollers **17a**.

In this modification the axis X—X of the mould is inclined relatively to the horizontal to the extent of an angle α. It results therefrom that the action PG of gravity, which is exerted on every particle P of the molten metal contained in the mould **1** and which is applied by centrifugal force against its internal wall **19**, can be decomposed into two components, one,

$$PN=PG.\ \mathrm{Cos}\ \alpha$$

at right angles to the axis X—X and the other,

$$PL=PG.\ \mathrm{Sin}\ \alpha$$

parallel to said axis and directed towards the lower part **27** of the mould. Each particle of molten metal is thus drawn along towards the lower part of the mould until, when it comes into contact with the free wall **19** of the mould, it cools, solidifies and comes to rest in its turn.

According to a modification illustrated in Figs. 11 to 12, the tubular member **23** made of steel cast by centrifugation is intended to serve as an electric line support. Its inner surface **24** has the shape of a truncated cone. Its outer surface comprises three parts: a truncated part **25** located on the side of larger diameter and intended to be embedded in the ground, a central part **26** also of general truncated shape, and intended to be placed at men's height, and an end part **27**, also truncated, longer than the preceding parts and constituting the top part of the post.

The central part **26** can be provided with external flutes **28** the cross section of which diminishes towards the small diameter of the post.

Fig. 6 illustrates the same tube during manufacture by centrifugal casting in a rotating mould **29**. Said mould is similar to that above described: it is essentially composed of a metallic frame **30**, an inner refractory lining **31** and two end walls **32** and **33** secured by keys **10**. The end wall **33** placed on the side of small diameter of the mould is perforated by a central orifice **34** for the injection of the molten steel. The frame **30** rests, by its rolling tracks **35** and **36** on rollers **37** and **38** through the medium of which it can be rotatably driven about the horizontal axis X—X, by means of a driving device, not shown. The refractory lining **31** has an inner surface **39** complementary to the outer surface of tubular post **23**; it can comprise flutes **40** intended to form the flutes **28** of the tubular post **23**.

The injection orifice **34** opens in alignment with the nozzle **41** arranged at the base of the casting pot **42**.

Owing to this method of construction of the moulds, each particle P of molten metal contained in a mould and rotatably drawn along is subjected to a centrifugal force PC which has a longitudinal component PL directed towards the bottom of the mould. This component is exerted on the molten metal throughout the length of the mould: it compensates the friction which would have the effect of progressively braking the flow of the metal and allows the latter to maintain its speed of advance on an increased distance. Owing to this arrangement much longer members can thus be obtained.

Calculation shows and experience confirms that a very small conicity suffices for exerting on the metal a very powerful action.

This action can be for instance calculated, in the case of a rotating mould having an average radius of 0.15 meter, a speed of rotation of 1.500 revolutions per minute and a very small conicity such that each of its generatrices forms an angle of $\frac{1}{1000}$ with the axis of rotation.

In this case a longitudinal acceleration component: PC=3,7 m/sec/sec, is obtained which is very important and which imparts great facility to the molten metal to proceed within the mould: this advance takes place in the same conditions as if the metal flowed freely; under the action of gravity, on a fixed inclined plane having a slope of

$$3{,}7 : 9{,}81=0{,}377$$

corresponding to an angle of inclination of 22 degrees.

It must be added that this very small conicity is easily obtained, for instance, in the case of sand moulds by giving the corresponding slightly conical shape to the metallic pattern used when clamping the mould. This clearance moreover allows the easy disengagement of said pattern after the preparation of said sand moulds; it has furthermore the advantage of facilitating the longitudinal shrinkage of the cast members and it renders their removal from the mould particularly easy after solidification.

Owing to the use of an inclined or truncated mould as above described, it is possible, for instance, to extend the length of the members obtained to 6 to 10 meters and even more, in the case of tubes having an internal diameter of several centimeters or of a few centimeters and a wall thickness of 2 to 15 millimeters.

It may be advantageous, for tubes of this length, to increase the initial speed of the metal at its inlet into the useful part of the mould.

This result is obtained for instance, according to the invention, by securing at the end of the mould **5** (Fig. 7) a rotating distributor **48**, having an inner surface **49** of truncated shape widening from the orifice **50** admitting the metal up to its junction **51** with the mould **5**. Said distributor is rendered rigid with the mould by screws **52** and it also rotates about the axis X—X.

The operation of said distributor is as follows: The molten metal **53** injected into the distributor through the orifice **50** comes into contact with

the inner surface **49** of the distributor by which it is rotatably driven. Each particle P of the metal is thus subjected to a centrifugal force PC at right angles to the axis X—X.

If the mass of the particle P is designated by m, its distance PH to the axis X—X by r, and the angular speed of rotation of the distributor **48** by ω, the value of the centrifugal force PC is given by the known formula:

$$PC=m.\omega^2.r$$

By designating by β the angle formed by each generatrix of the truncated distributor **48** with the axis X—X, and by decomposing the force PC into its two components: PN at right angles to the wall of the distributor and PF directed according to a generatrix of said wall, it will be seen that the distributor according to the invention has the effect of exerting on each part of the metal a force one of the components of which:

$$PN=m.\omega^2.r.\text{Cos } \beta$$

is perpendicular to the wall **49** of the distributor and applies the metal against said wall, and the second component of which:

$$PF=m.\omega^2.r.\text{Sin } \beta$$

parallel to the generatrix of the truncated cone passing through P has for result to promote the movement of the metal towards the mould.

This latter force, which is proportional to the second power of the speed of rotation, increases as the radius r, that is to say very gradually, in proportion as the metal moves from the inlet of the distributor towards the mould and without causing any perturbation in its flow.

Owing to the invention, a very high longitudinal speed can thus be imparted to the metal at the moment it enters the mould, which allows it, before it loses its temperature and fluidity, to cover a longer distance within said mould: the possibility of producing members of increased length results therefrom.

The drawing along of the molten metal and the operation of the distributor can be improved by giving to the latter a rough internal surface. According to the embodiment illustrated in Fig. 8, this result is obtained by providing the inner surface **54** of the distributor **48** with longitudinal ribs **55** which become impressed in the molten metal and accelerate its centrifugal rotation.

The divergent rotating distributor can, according to the invention, be devised in various manners. Fig. 9 illustrates an embodiment in which the rotating mould is externally provided on the side of the casting orifice **13** with a series of cooling ribs **56**. On the other hand, the thickness of the refractory lining **59** is greatly reduced straight below said ribs, so that, in this part of the mould, the cooling of the latter and consequently, that of the molten metal are considerably increased.

Said device operates as follows: At the beginning of the casting an important amount of metal **57** solidifies at the inlet to the mould and the inner surface **58** of said solidified portion assumes a truncated shape which acts as a divergent distributor on the molten metal subsequently injected into the mould.

If the presence of this reinforced portion is not desired in the cast member, it suffices to section it after removal from the mould, according to the plane Z—Z for obtaining a tubular element having the desired internal cylindrical shape.

It is very important to emphasize the simplicity of the new method for manufacturing said members: it allows, in fact, of directly obtaining finished members starting from molten metal and by avoiding any other metallurgical or shaping operation. A considerable reduction of the expenses of the plant, labour, fuel, and exploitation as well as an appreciable diminution of the metal losses result therefrom, relatively to the other processes.

Moreover, the invention has the great advantage of being indistinctly applicable to all metals or other fusible bodies, and in particular to those which do not lend themselves to other shaping processes.

By eliminating the use of a long casting conduit penetrating into the mould, the invention can be moreover applied to be utilisation of very small moulds and thus allows of manufacturing members of a smaller diameter than the other known centrifugal casting methods.

The method according to the invention has finally the great advantage, relatively to the other known methods, of producing members soundly constituted. Thus in the casting of metals in general, the formation of shrinkage holes in the thickness of the members is only avoided provided that the solidification of their walls takes place and proceeds according to a single working face; shrinkage holes are unavoidably produced each time the molten metal solidifies and shrinks in a closed space limited by two or more solidification faces which advance to meet each other. In the manufacture of long and thin tubular members and in particular of thin tubes, a solidification face is compulsorily formed at the outer surface of the member, owing to the cooling action of the mould. It is therefore essential to prevent the formation of another solidification face starting from the inner surface of the members. This result is obtained owing to the casting method and to the shape of the mould according to the invention.

In fact, the metal already stationary in the mould is protected from any cooling action from within the mould, by the layer of hotter molten metal which flows and is constantly renewed within the member. On the other hand, the outer cold air is prevented from entering the mould by closing the latter at both its ends by two end walls, one only of the end walls being perforated with an orifice as reduced as possible for the injection of the molten metal.

According to the embodiments illustrated in Figs. 1, 4, 5, 6 and 9, the orifice **13** or **34** for the injection of the molten metal opens opposite the nozzle **14** or **41** through which spurts the molten metal **17** or **43**. Said orifice can also be enlarged to allow the introduction of the nozzle **14** into the mould or into the distributor **48** as shown in Fig. 7, this latter arrangement having the advantage of avoiding any projection of molten metal outside the mould. In both cases, the annular clearance existing between the orifice **13** on the one hand, and, on the other hand, the jet of molten metal **17** or the outside of the nozzle **14**, must be reduced to the minimum.

At the beginning of casting, the air contained in the mould suddenly expanding very rapidly escapes outside. It is moreover known that molten metals contain a considerable quantity of dissolved gases or gases in the combined state. Said gases spontaneously evolve upon cooling and centrifugation appreciably accelerates the elimination of the gases from said metals in the molten or pasty state. The hot gases which, after the air escapes from a centrifugal mould such as above

described, are for the greater part combustible gases; they ignite and burn at the outlet of the hole of the casting cup; it has been found that the flame persists for a relatively long time after the solidification of the metal is terminated, which allows of affirming that the external atmosphere does not at all penetrate into the tube or other member in course of solidification.

It results therefrom that the inner wall of said tube is sheltered from any cooling action exerted by the ambient air; it can only cool by contact with the external concentric layers which, in their turn, cool by contact with the centrifugal mould or chill. In other words, the calories of the metal flow radially in a single direction, that according to which centrifugal force acts, and the metal solidifies according to a single face at right angles to said direction. It results therefrom that no portion of the molten metal solidifies in a closed space limited by two or more solidification faces advancing to meet each other. Owing to this very advantageous feature of the invention, it has been proved that the tubes cast by centrifugation in accordance with the method and/or by means of the devices above described, have walls rigorously free from shrinkage holes.

The present invention therefore allows not only of obtaining by simple casting, that is to say in very advantageous economical conditions, thin and long tubular members, but also of avoiding the various defects which are frequent in the members obtained by other methods. Thus, the unevennesses in wall thickness are avoided by the centrifugal casting, and the longitudinal unevennesses by the method of distributing the metal along the mould.

Furthermore, the solid or gaseous inclusions are also driven out by the extremely intense action of centrifugal force, and the shrinkage holes eliminated by the particular cooling method directed exclusively from the exterior towards the interior of the member. Finally, the members obtained are perfectly isotropic at every point.

The long and thin tubes and other tubular members made of cast metal obtained according to the invention present numerous other advantages relatively to similar members obtained up to now by known ingot casting, forging, punching, rolling, drawing or other processes.

Furthermore, they can be constituted by any steel or other metal or alloy whatever, without it being necessary that the latter should satisfy the conditions of malleability, rolling, weldability, limited shrinkage, etc. This feature considerably extends the possibilities of the art and allows of using, for instance, new varieties of steel or other ferrous alloys which, up to the present, have not been practically used notwithstanding their particular advantages, either because they are industrially unsuitable for rolling, or because they are difficultly weldable, or because they have an important shrinkage, or for any other reason.

For instance, the invention is applicable to tubes for pipe-lines embedded in the ground, made of steel having 13% of chromium. As this steel is only slightly oxidizable, the tubes can be given a smaller thickness solely conditioned by the mechanical stresses to which said tubes are subjected owing to the internal pressure of the fluid conveyed or to external overstreses.

The regularity of these members is as remarkable as the quality of the metal constituting their walls; in fact, the unevennesses in wall thickness are avoided by centrifugal casting and the longitudinal unevennesses by the method of distributing the metal along the mould.

Finally, the members according to the invention are perfectly isotropic at all their points: they do not have the fibrous structure of members obtained by rolling: this feature is particularly advantageous for members subjected to corrosion, in particular, for the tubes of underground pipe-lines, as a fibrous structure promotes, as is known, the corrosion of the metal.

In addition to the embodiments illustrated in Figs. 10 and 11, the members manufactured can be cylindrical on a portion of their length and conical on another portion, or more generally can have an outer shape which flares towards the larger end of the mould. They can be externally provided with projections which are not flared provided that the inner surface of the member does not appreciably depart from the shape of the cylinder or truncated cone, and provided the mould is destroyed for allowing the removal of the member after each casting operation.

The cross section of the members can be circular or on the contrary have any external polygonal or like shape, or can be provided with flutes or grooves. The shape of said cross section can moreover vary along the mould.

The pipe-line tubes made of centrifugal steel can also have a widened end serving to constitute a socket joint: said widened end being provided only outside the member, the inside of the latter remaining cylindrical at the time of casting to be subsequently subjected to a suitable shaping or, again, the interior of the socket joint being also formed at the time of casting by means of a fitting core secured at one end of the mould, as known per se.

Finally, the length, thickness and internal diameter of the tubes and other tubular members can vary within wide limits; the values above indicated being given by way of example and not in a limiting sense. Said members can be used such as they issue from the mould or, on the contrary, can be subjected to any subsequent transformation.

Of course the invention is not limited to the embodiments illustrated and described which have been chosen only by way of example.

It can thus be applied not only to steel, but also to any metal, alloy or other fusible material capable of passing from a molten or pasty state to a solid state, whether this change of condition takes place upon cooling, as described, or for any other physical, chemical or like reason.

The mould can be destroyed at each operation, or on the contrary can be permanent, for instance, entirely metallic. It can have any other shape, for instance a cylindrical shape on a portion of its length and truncated on another portion, or the shape of a paraboloid of revolution.

The surface of the mould can be provided with counter-tapper parts which do not affect the general shape of the mould, provided said parts are destroyed or taken to pieces after each casting for allowing the removal of the members.

The cross section of the mould can be circular as illustrated, or on the contrary, it can have any fluted polygonal or like shape: the shape of the cross section can moreover vary along the mould. For instance, in the casting of pipes, one end of the mould can be widened for forming the socket joint of the member.

Use can also be made of a mould inclined towards the casting orifice, but sufficiently flared

for the longitudinal component of centrifugal force to be greater than the longitudinal component, directed in reverse direction, of gravity. Conversely, use can also be made of a mould flared towards the casting orifice but sufficiently inclined in the reverse direction for the longitudinal component of gravity to be greater than that of centrifugal force.

The orifice for the injection of the metal can be arranged exactly at the center of the end wall of the mould or, in particular, in the case of a mould of large diameter, it can be out of center and placed for instance in the vicinity of the lower generatrix of the mould; in this case, a fixed cheek member can be used for obturating as completely as possible, the end of the mould and thus prevent, according to the invention, the entrance of the cold ambient air into said mould.

The divergent rotating distributor made of metal or of refractory material, can be secured in position and rotatably driven independently of the mould, at a speed equal to or different from that of the latter. The profile of said distributor can be truncated as shown, or can have any other general divergent shape, such as that of a sector of a paraboloid of revolution. Its surface can be smooth, rough, striated or grooved.

On the other hand, not only can a constant impulse be imparted to the metal or constant forces exerted thereon during the entire casting period, but said impulse and/or said forces can be varied during the operation, for instance at the end of the casting, either by modifying the speed of rotation or the inclination of the mould, or by changing the level of the molten metal in the casting pot.

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JUNE 1, 1943.	CENTRIFUGAL CASTINGS	453,655
BY A. P. C.	Filed Aug. 5, 1942	3 Sheets-Sheet 1

Fig. 1

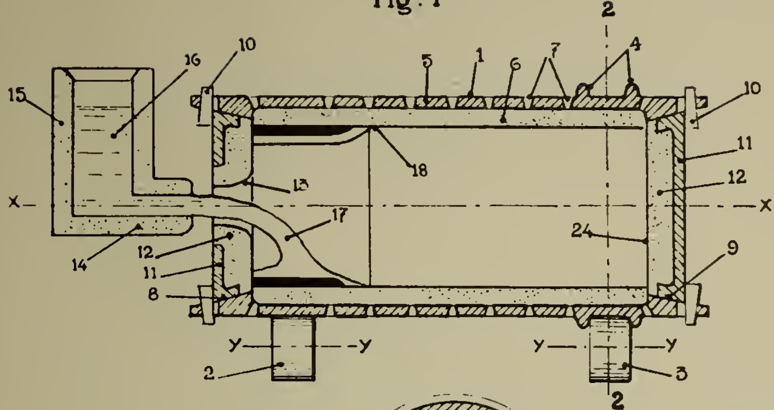
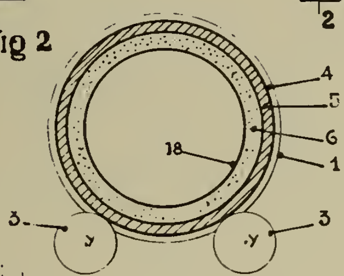


Fig 2



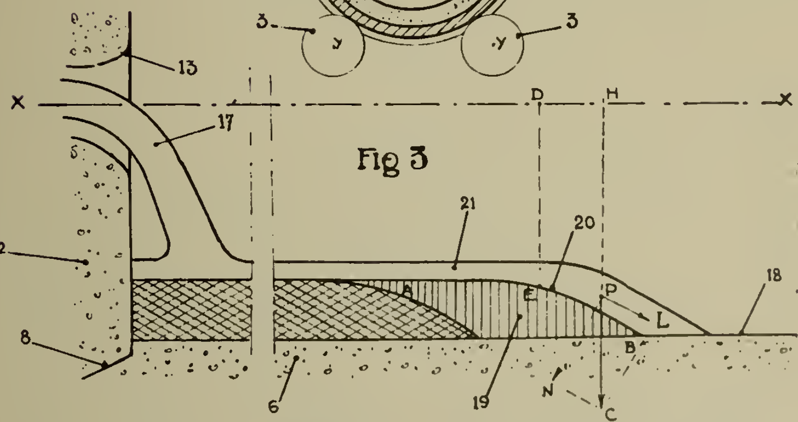


Fig 4

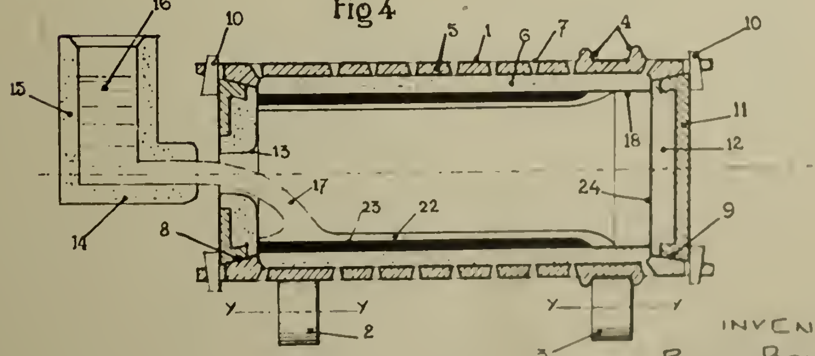


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Fig 10

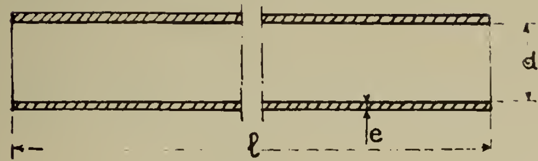

Fig.5

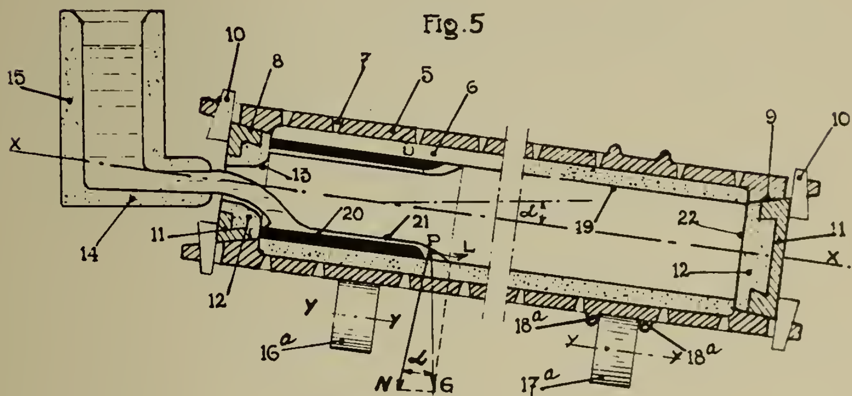

Fig.11

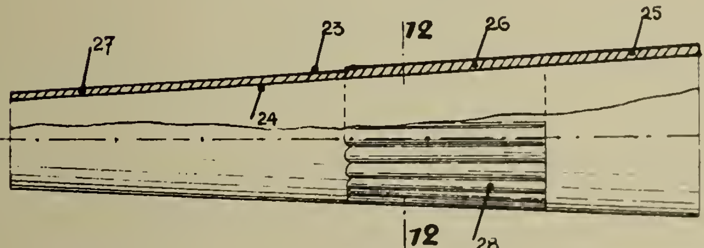

Fig.12

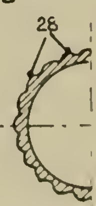

Fig.6

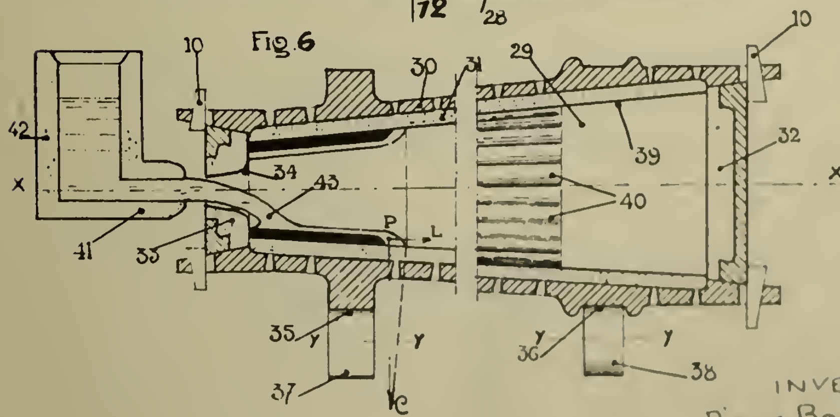

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Fig. 7

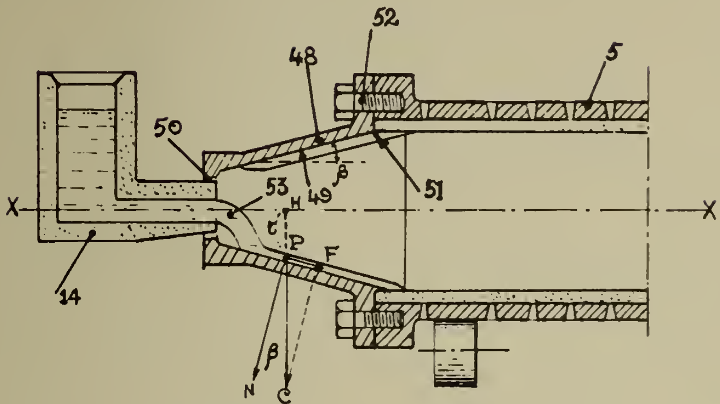


Fig. 8

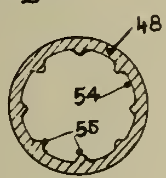
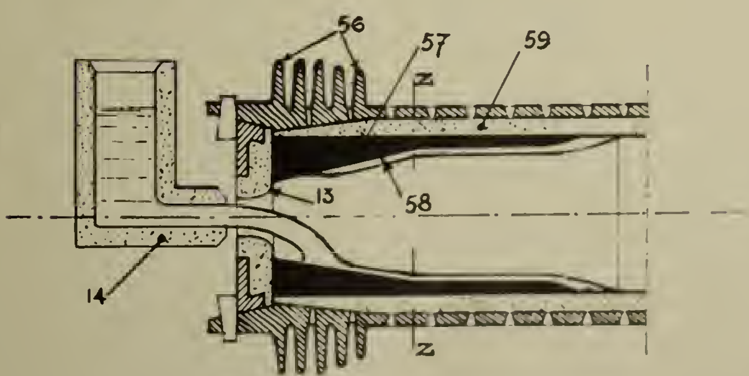


Fig. 9



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ALIEN PROPERTY CUSTODIAN

CHAIN TRANSMISSION MORE PARTICULARLY FOR CYCLES

Gaston Lapeyre, Tarbes, Hautes-Pyrenees, France; vested in the Alien Property Custodian

Application filed August 5, 1942

My invention relates to improvements into variable speed gears of the kind in which chain transmissions are provided with chain tripping devices. It is known that the gears of this kind have various drawbacks, inter alia: a reduced range of speeds, a rapid wear of the chain on account of its obliquity with respect to the driving and driven sprockets for the end gear ratios, the practical impossibility to shift from one speed to another while the chain is transmitting a substantial effort, frequent falls of the chain and, lastly, in the case of bicycles, complications in dismounting the rear wheel due to said gears.

The invention aims at doing away with these drawbacks and at providing a simple, strong and light gear, free from the above-mentioned defects and permitting to obtain an extensive range of numerous speeds.

In accordance with the invention a gear is provided which is remarkable more particularly in that the chain runs round a driving sprocket which is supported on a rocking arm and is itself rotatably driven round its own axis, through the medium of a preferably multiplicating transmission, from a rotatable element concentric with said rocking arm. Between the source of power and the chain a epicyclic transmission is thus provided since the driving sprocket of the chain is rotatable both round its own center and round the rocking arm center.

The advantages of such an arrangement are numerous and substantial. On the one hand, tension is automatically produced on the two sides of the chain due to the tendency of the driving sprocket to be rocked about the rocking arm axis; hence the chain will always be correctly stretched and remain so whatever may be the diameter of the driven sprocket in actual use; on the other hand, when shifting the chain from a driven sprocket on to another driven sprocket of different size, the two sides of the chain vary simultaneously and equally in length, whereas in the known systems only the slack side of the chain was varied in length, so that compensating this variation in length in view of maintaining the chain suitably stretched was more difficult. Besides, in case of an abnormal resistant stress, as when the chain is being shifted from one sprocket on to another, for example, the rocking arm yields and returns rearwardly while a compensation is obtained at the same time through differential rotation of the driving sprocket; this action permits in particular to effect this shift while the driving effort is in the course of being expended and whatever may be the intensity of said effort. This facility in shifting permits also to use driven sprockets whose diameters differ much more widely than hitherto usual. The result is that, for a given number of driven sprockets, the scale of speeds is much more extensive with the present gear than with the usual gears hitherto used. Besides, due to the presence of the multiplicating transmission the diameter of the driving sprocket of the chain is not very differing from those of the driven sprockets, so that the obliquity assumed by the chain when running round the extreme driven sprockets is much less hurtful, and the chain is not submitted to an abnormal wearing stress.

A further advantage of this arrangement is that it permits to mount co-axially and side by side several driving sprockets of different diameters adapted to be selectively brought into engagement with the chain. A very extensive scale of speeds is thus obtained, with a number of speeds equal to the product of the numbers of driven and driving sprockets.

Another advantage of this arrangement is that it permits to slidably arrange the driving sprocket or group of sprockets. The chain may thus be caused either to be always exactly in alinement whichever may be the sprockets in actual use, or, in view of reducing the stroke required for the slidable sprocket or group of sprockets, out of alinement only by an amount not exceeding the thickness of a sprocket, as this requires only that the stroke of the slidable group of sprockets be equal to the thickness of two sprockets.

Preferably, the said multiplicating transmission consists of a driven sprocket having sprocket teeth meshing internally with a driving lantern wheel concentric with the movable arm.

It is also advantageous, in case this transmission mechanism is provided with a free-wheel device, more particularly when applied to cycles, that the free-wheel mounted sprocket be that driving sprocket which is carried on the rocking arm. This arrangement makes it still easier to shift the chain from one sprocket on to another since it permits of effecting such a step while the machine is coasting; i. e. while the driving sprocket is overrun, the chain being then but slightly stretched by the rocking arm and driven by the driven sprocket owing to inertia.

As examples, to which the invention is in nowise limited, two different manners of carrying out the various improvements above mentioned, here shown as applied to a bicycle, are hereafter described with reference to the annexed drawings in which:

Fig. 1 is an elevational view of the front sprocket wheel; of a bicycle specially designed in view of the application of the new gear;

Fig. 2 is a cross section on the line II—II of Fig. 1;

Fig. 3 is a similar view to Fig. 1, showing another embodiment applied to a bicycle of the common kind;

Fig. 4 is a cross section on the line IV—IV of Fig. 3.

In the example of application as shown in Figs. 1 and 2, the usual frame of the bicycles is slightly altered at the crank bracket, inasmuch as the chain stays 1 are provided forwardly of the seat tube 2 with a short extension 3 carrying an upwardly extending lug 4. From the front end of said extension 3 extends the bottom tube 5 of the frame. The lug 4 is provided transversally of the bicycle plane with a cylindrical bore through which extends a cylindrical cage 6 supported on two sets of rolls 6′ arranged in said lug 4. The spindle 7 of the pedal cranks 8 is mounted in the usual manner in said cage 6 by means of threaded cups 9 and balls 10. On the outside of said cage, which protrudes on both sides of the lug 4, is carried a forked arm 11, the limbs of which engage with the worked side faces of said lug. Said arm 11, extending upwardly above the spindle 7, terminates at its upper end in a perforated lug 12 whose axis is parallel with that of the cage 6 and in which is supported, by means of screwed cups 13 and balls 14, a spindle 15. On one side, the latter is provided with a rather long extension protruding from the lug 12, and on the same side, the crank spindle 7 protrudes also substantially out of the cage 6. On the protruding part of the spindle 15 are secured a set of three sprockets 16, 16*a*, 16*b* arranged side by side and of different sizes and, at the end of said spindle a fourth sprocket 17, meshing internally with a lantern sprocket wheel 18 whose trundles consist of rollers 19, which are similar to those of chains and held between a rigid perforated plate 20, integrally connected with one of the cranks 8′ and a counter-plate 21 consisting of a plain rigid ring. The sprocket 17 is provided with teeth similar to those of a usual chain sprocket, so that the meshing action between said sprocket and the special sprocket wheel 18, which is substituted to the usual bicycle front sprocket wheel, is exactly similar to that between a sprocket and a chain. A light torsion spring 22 is coiled round the cage 8, the ends of said spring being hooked upon the arm 11 and the chain stays 3, respectively, so as to exert upon said arm a force tending to rotate the same in the direction of the arrow *f*. i. e. forwardly.

A usual chain 23 runs round one of the sprockets 16, 16*a*, 16*b* and one of the sprockets, not shown, of the rear wheel. The tripping of the chain when the latter is to be shifted from one sprocket of the rear wheel on to another is controlled by any one of the usual shifting devices, the fork of which engages with the driven side of the chain and is adapted to be transversally moved from a removed control member, through the medium of a suitable transmission, preferably a cable transmission. Another control device of this kind is provided, in the present instance, to control the shifting of the chain from one of the driving sprockets 16, 16*a*, 16*b* on to another. This device comprises a fork 24, which is slidably mounted on the seat tube 2 and engages with the driving side of the chain at a position close to the rocking arm 11. Said fork 24 is adapted to be shifted transversally through hte medium of a cable 25.

The operation of this mechanism is as follows: When the wheel 18 rotates it ends to cause the rocking arm 11 to move in the same direction, this tendency being however counteracted due to the engagement of the chain 23 with one of the sprockets 16, 16*a*, 16*b*. The sprocket 17 is consequently caused to rotate round its own center and carries with it the spindle 15. The set of sprockets 16, 16*a*, 16*b* and the chain 23. To the tension exerted on the driving side of the chain by the transmitted force will be added an additional tension produced by the force tending to rotate the arm 11, and since this additional tension acts also on the driven side, any sagging of the latter is avoided. When stopping, the spring 22 counterbalances the force exerted on the arm 11 due to the weight of the chain, the latter being thus maintained slightly stretched.

In order to change speed, as for example by causing the chain to be shifted from the driving sprocket 16 on to the nearest sprocket of larger size 16*a*, thus obtaining a higher gear, the chain must be shifted crosswise by means of the fork 24 operated through the cable 25; the chain begins to grip the sprocket 16*a* and, on account of the peripherical speed of said sprocket being higher than that of the chain, which continues to be driven from the sprocket 16, the arm 11 is rocked rearwardly; during this rocking motion, the driving side of the chain remains stretched and continues to transmit the driving force, while the driven side and that portion of the chain which is still coiled round the sprockets 16 are slackened, thus avoiding any abnormal tension of the chain and securing a very smooth shifting of the chain from the sprocket 16 on to the sprocket 16*a*. Shifting of the chain from the sprocket 16*a* on to the sprocket 16*b* of larger size is similarly effected. As soon as the chain has been transferred from one sprocket to another, its two sides are again tensioned by the arm 11, which tends to be returned forwardly until a position of equilibrium is reached when the tension of the chain is equal to the driving force exerted on said arm 11.

In order to shift the chain from a driven sprocket to another driven sprocket of larger size, the driven side of the chain is acted upon by means of a simple fork so as to be shifted transversally; the excess tension which tends to be applied to this side, due to said shifting step and to said side beginning to be driven by the new sprocket of larger size, causes the arm 11 to be returned rearwardly, while the driving side remains stretched and continues to transmit the force, due to a compensating differential rotation of the driving sprocket. The amount of excess tension is consequently always very small. The chain is then shifted in the same manner as in the case of the usual gears of this kind, any abnormal tension of the driving side being however avoided since it would immediately cause a greater rocking of the arm 11 rearwardly and, hence, an immediate slackening of the tensioned driving side. As soon as the chain has finally been lapped on to its new sprocket, the arm 11 slightly rocks forwardly to a position of static equilibrium.

Likewise, when shifting the chain from a driving or driven sprocket to another of smaller size, any excess tension of one of the sides of the chain causes immediately a rearwardly rocking of the

arm 11, so that said excess tension is limited to a very small amount.

It follows that, in all cases, the chain is shifted from one sprocket to another with much suppleness and smoothness without stressing or danger of breaking the chain or the sprocket, even when a full driving effort is effected.

It will be noted that the rocking arm is so arranged that its own weight tends naturally to cause the same to rotate in the direction of the arrow *f*, thus producing a tension on the chain.

In the alternative embodiment shown in Figs. 3 and 4, the cup 31 of the sprocket wheel is provided externally with a co-axial cylindrical bearing surface 32 on which is freely and rotatably fitted the hub of a forked rocking arm 11', retained axially by means of a nut 33 screwed on the threaded end of said bearing surface 32. To the limbs of this forked arm 11' is secured a spindle 27' on which is tightly fitted a needle bearing 35, the outer race sleeve 36 of which is provided with longitudinal splines 37. On the latter is slidably fitted the correspondingly spined hub of a free-wheel device 38, on the outer crown of which two sprockets 16', 61'*a* are secured which correspond to the sprockets 16, 16*a* of the previously described arrangement; as in the latter, a sprocket 17' meshes with a lantern wheel 18' secured to the cranks 8', though, in the present case, said sprocket 17' is fastened to the outer race sleeve 36 of the needle bearing 35, so that the free-wheel device 38 is inserted between said sprocket 17' and the group of sprockets 16', 16'*a*. A spring 22', housed in a groove of the cup 31 and whose ends are respectively hooked in holes provided transversally of the axis in the cup and the hub of the arm 11', tends to rotate the latter in the direction of the arrow *f*. Said hub consists of two cheeks spaced from each other. On the bearing surface 32 is also freely mounted to rock between said cheeks an arm 40 which terminates in a fork 41 supporting a spindle 42 on which a roll 43 to guide the chain 23' is adapted to slide. On the arms 11' and 40 are hooked the ends of a spring 44 which is connected between said arms so as to tend to move the same away from each other. Moreover said arm 40 is so arranged that the tension of the chain on the guide roll 43 gives a resultant force the moment of which, with respect to the sprocket wheel axis, tends to cause the arm 40 to rock towards the rocking arm 11' against the action of the spring 44 and thus to reduce the length of the path which the chain side passing round said roll 43 is compelled to follow. The position of the chain is controlled, as in Figs. 1 and 2, by means of a movable fork, not shown.

It will be observed that, in this embodiment, the path of the chain is partly above and partly underneath the sprocket wheel spindle, as in the usual gears, in contradistinction to the embodiment of Figs. 1 and 2, in which the two sides of the chain are on the same side, i. e. the upper side of the sprocket wheel spindle.

Owing to the fact that the free-wheel device is mounted on the rocking arm instead of being mounted on the sprocket wheel, it is obvious that the chain runs constantly with said sprocket wheel, and it is thus possible to shift the chain from one sprocket on the another without pedalling being necessary.

On the other hand, as in the previously described arrangement, the tension on the two sides of the chain is ensured by the rocking arm 11', the purpose of the guide roll 43 being not to tension the driven side of the chain, but to remove said side from the sprocket wheel. The moment of the resultant force of the tension of said driven side on the roll 43 with respect to the sprocket wheel axis is counterbalanced by the spring 44. As the chain is tripped in order to cause the same to rise from one of the rolling sprockets carried by the rocking arm on to another, the gear operates in the same manner as described above with respect to Figs. 1 and 2; i. e. the arm 11' rocks rearwardly under the momentaneous excess tension to which the chain side beginning to roll itself on said new sprocket is submitted; as the chain is tripped to cause the same to rise from one of the other rolling sprockets at the opposed end of the chain on to another, the excess tension on the chain side beginning to roll itself on this sprocket does not cause any tendency of the arm 11' to rock rearwardly, but causes the arm 40 to rock against the action of the spring 44, thus reducing the length of the path which said chain side is compelled to follow and facilitating the lapping motion of said side on to the new sprocket.

This embodiment has more particularly the advantage of permitting the easy conversion of an already built machine, since all that is needed for this purpose is to substitute the cup 31 to the usual cup of the sprocket wheel, a crank spindle of increased length to the usual crank spindle and a lantern wheel to the usual large sprocket wheel, whereas the embodiment shown in Figs. 1 and 2 necessitates a conversion of the frame.

Obviously, the invention is in nowise limited to the details of construction shown or described, as the same are only given as an example. Thus, in particular, any number of driving or driven sprockets may be provided; for example, the gear may be equipped with only one driven sprocket and several driving sprockets, or with only one driving sprocket and several driven sprockets. In like manner, the driving sprockets may be shiftable, or non-shiftable, whatever may be otherwise the embodiment chosen.

It will also be noted that the mounting of the free-wheel device on the rocking arm applies equally well to the embodiment of Figs. 1 and 2 as to that of Figs. 3 and 4. The same may be said of the mounting of a splined spindle of the chain rolling sprocket or sprockets carried by the rocking arm. The mounting of the rocking arm on a cup of the sprocket wheel may also be used with the two sides of the chain arranged to pass on the same side of the sprocket wheel axis; if said axis is located between the two sides of the chain the arm carrying the chain guide roll may be excentrically jointed to said rocking arm instead of concentrically as described above.

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CHAIN TRANSMISSION MORE PARTICULARLY FOR CYCLES

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3 Sheets-Sheet 1

Fig. 1

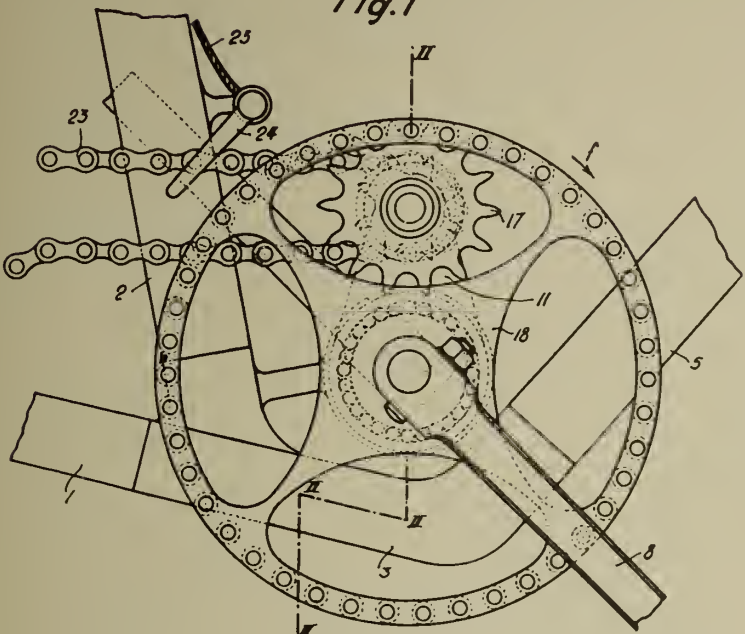

Fig. 2

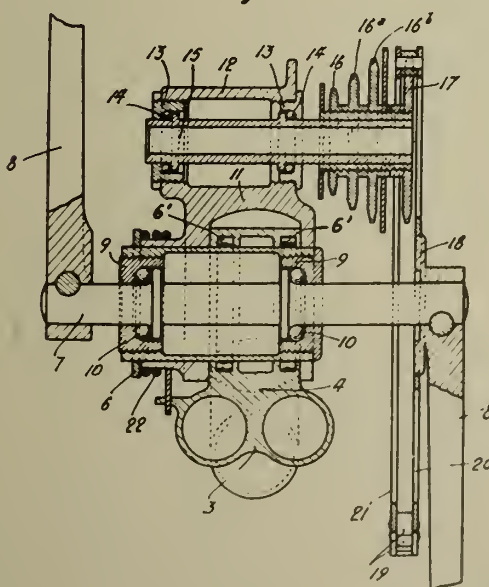

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Fig. 3

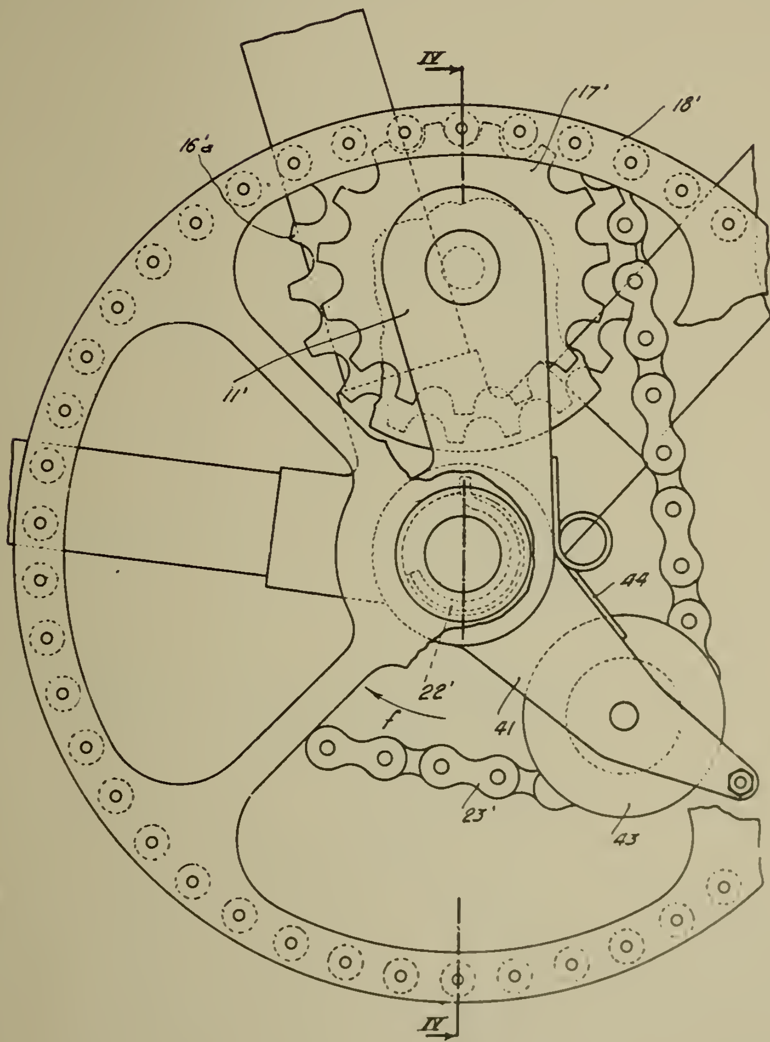

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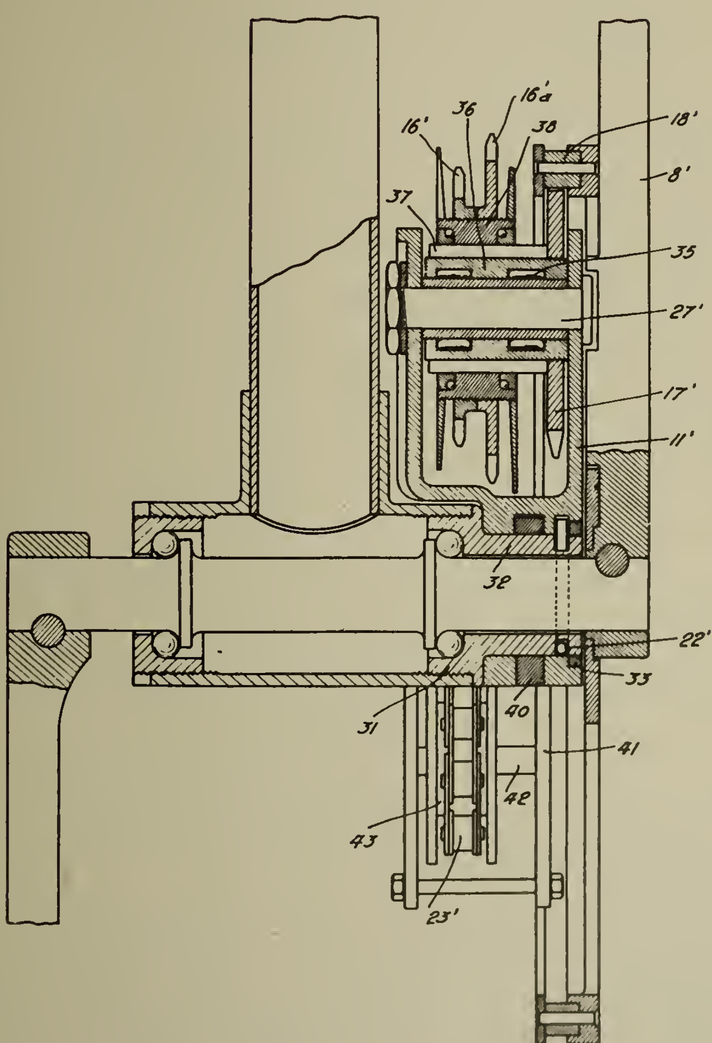
Fig. 4



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Serial No. 455,908

ALIEN PROPERTY CUSTODIAN

VIBRATIONS DAMPERS

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Application filed August 24, 1942

The present invention relates to vibration dampers of the centrifugal pendulum type, these apparatus essentially including pendular masses eccentrically suspended to a rotating body and adapted to start into oscillation under the effect of the vibration to be damped, in phase opposition therewith.

These pendular masses must, in order to have the maximum efficiency, be mounted in such manner as to be able to oscillate with the minimum of friction. For this purpose, I have already suggested to connect them with their rotating support through rolling devices and preferably through the medium of rolling bodies bearing, on the one hand, upon runways carried by the rotating support, and, on the other hand, upon runways carried by the pendular mass.

According to some embodiments of this arrangement, which have already been proposed by me, these rolling bodies are in the form of members, for instance of annular shape, including internal rolling surfaces, these members being subjected to tensile stresses under the effect of the centrifugal force and of the tangential accelerations to which the masses are subjected.

Such members have the disadvantage of being deformable, due to their very shape, unless they are made very heavy, which however, is undesirable for functional reasons. Therefore, up to the present time, it had been preferred to make use of cylindrical rolling bodies having external rolling surfaces.

The chief object of the present invention is to provide an apparatus of the type above referred to including, for the rolling suspension of the pendular masses thereof, rolling bodies having internal rolling surfaces, which is better adapted to meet the requirements of practice, this result being obtained, in particular, due to the fact that the rolling bodies are both sufficiently rigid and of light construction.

According to an essential feature of the present invention, the apparatus includes, for connection of the pendular mass with the rotating support of said mass, at least one rolling body provided with internal rolling surfaces adapted to coact with two convex runways, one of which is carried by the pendular mass and the other by the rotating support and these rolling bodies are provided with bracing means opposing deformation of said body under the effect of the tensile stresses to which it is subjected in the course of its operation.

According to a preferred embodiment of my invention, the bracing means consist of a web extending symmetrically inside a rolling member of annular shape, the internal surface of said annular member coacting with runways provided on lugs extending on either side of said web.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

A preferred embodiment of the present invention will be hereinafter described with reference to the accompanying drawings given merely by way of example and in which:

Fig. 1 is an end view of a torsion vibration damper made according to the present invention;

Fig. 2 is a part view on an enlarged scale corresponding to Fig. 1;

Fig. 3 is a sectional view on the line III—III of Fig. 2;

Fig. 4 is a sectional view on the line IV—IV of Fig. 3.

In the following description, it will be supposed that the invention is applied to a torsion vibration damper to be mounted on a rotating shaft.

This damper includes, in a known manner, two pendular masses **1**, connected through a bifilar suspension, to a plate **2** carried by said shaft.

The particular suspension according to the present invention is made in the following manner:

Mass **1** is provided with two convex runways **3**, identical to each other, preferably of the form of portions of cylindrical surfaces of a radius equal to r^1, the runways being arranged in such manner that, when the pendular mass **1** is in position with respect to plate **2**, the runways have their convexity turned away from the axis of revolution of said plate **2**.

Plate **1** is provided with two convex runways **4**, located at the same distance from each other as runways **3**, and which are given the form of portions of cylinders of a radius equal to r_2, and have their convexity turned toward the axis of revolution of plate **2**.

Runways **3** and **4** are arranged in such manner that each runway **3** is located opposite a runway **4** respectively.

I provide, around each set of cooperating runways **3** and **4**, a rolling body **5** including two internal rolling surfaces **6** and **7**, preferably of cylindrical shape, and having respective radiuses equal to r_3 and r_4. These rolling surfaces are intended to coact with runways **3** and **4** so as to obtain the suspension with the desired pendular radius r.

Preferably, r_1 and r_2 are chosen of the same

value and also r_3 and r_4. In this case, the pendular radius r is equal to 2 $(r_3—r_1)$.

If $r_3=r_4$, the rolling body **5** can be given the shape of a body of revolution.

In any case, according to my invention, this rolling body is provided with bracing means capable of opposing deformation of said body under the effect of the tensile stresses to which it is subjected in the course of operation.

Advantageously, these bracing means are constituted:

(*a*) either by at least one reinforcing part carried by the rolling body and adapted to increase, at least in certain zones, the moment of inertia of its section;

(*b*) or, preferably, by a web **8**, for instance of solid structure, extending inside the annular member which constitutes the rolling body and perpendicular to the axis of said annular member.

This embodiment is that shown by the drawings.

In this example, each of the rolling surfaces **6** and **7** is preferably constituted by two portions in line with each other, located on either side of web **8**, the whole of the rolling body being then symmetrical with respect to the medium plane of its web and having the shape of a disc provided with a cylindrical hole on each of its faces.

As for the runways **3** and **4**, they are also divided into two halves, in line with each other and forming studs or lugs adapted to engage in said cylindrical holes respectively.

Advantageously, these lugs are carried by plates such as **9**, **10** fixed respectively, for instance by means of bolts, on the one hand to plate **2** and on the other hand to mass **1**, in such manner that the two lugs corresponding to a given runway are in line with each other and extend toward each other. For this purpose, it is advantageous to provide, between each of the plates **9**, **10** and the element **1** or **2** which must support it, an engagement ensuring a correct positioning and fixation of the runways.

It will be readily understood that once the different elements have been assembled together, the rolling bodies **5** are mounted in housings closed laterally by plates **9** and **10** and that the pendular movement can then take place, provided of course that the desired plays have been provided between, on the one hand, the rolling body **5** and, on the other hand, masses **1** and plate **2**.

Whatever be the particular embodiment that is chosen, I obtain a device the operation of which results sufficiently clearly from the preceding description for making it unnecessary to enter into further explanations.

This device has many advantages, the most important of which are the following:

The rolling body cannot be deformed, owing to the provision of web **8** which stiffens it;

The stresses applied to the rolling body by the runways are well distributed, in a symmetrical manner with respect to web **8**;

The zone of contact between the lugs **6**, **7** and the rolling body **5** is of maximum length, since this length can be equal to the total thickness of the apparatus, only decreased by the thickness of web **8** (for instance two or three millimeters) and by that of plates **9** and **10**;

Finally, the rolling bodies are perfectly maintained in transverse position.

Of course, the arrangement above described has no limitative character and, for instance, the rolling bodies, instead of being constituted by annular bodies of revolution, might be formed by annular portions connected by a web or again by non circular annular members.

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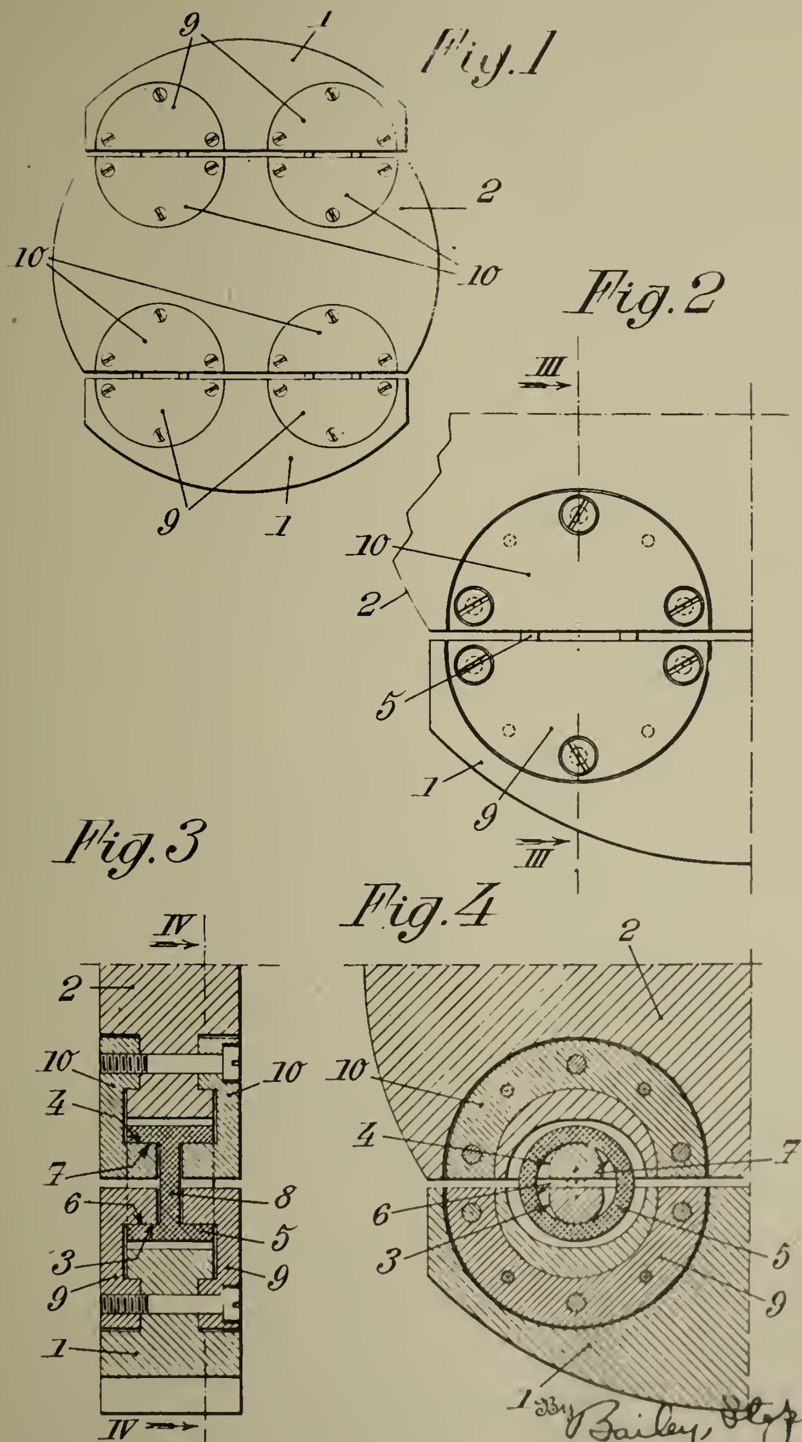

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ALIEN PROPERTY CUSTODIAN

ELECTROTHERMIC GAS PRODUCER

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Application filed September 1, 1942

As is known, the use of electrical energy for producing the necessary heat and so raising the temperatures of reactions in industrial furnaces while so meeting the endothermic requirements as to generate plant gas was already contemplated. However, no practical application ensued owing to the absence of a suitable appliance capable of fulfilling the aforesaid requirements.

An object of the present invention is to provide a new or improved electric furnace adapted to work as an electrothermic gas producer fulfilling said requirements and ensuring steady and reliable operation while lending itself to an easy adaptation to industrial conditions by only requiring to be energized at certain spaced periods of time as for example during off-peak hours when current is cheaper or easier to supply.

Another object of the invention is to provide an electrothermic gas producer wherein the resultant ashes may be discharged in the form of slags or alloys of metals reductible by carbon under usual service conditions.

A further object of the invention is to provide an electrothermic gas producer utilisable for the manufacture of alloys and metal carbides on a large industrial scale while giving rise to a substantial evolution of carbon monoxide.

A still further object of the invention is to provide an electrothermic gas producer lending itself to the easy recovery of carbon monoxide arising from the manufacture of alloys and metal carbides and also to the collection of vapors of metals such as zinc and magnesium, and to all processes wherein gases or vapors are extracted or converted.

With these and such other objects in view as will incidentally appear hereafter, the invention comprises the novel construction and combination of parts that will now be described with reference to the accompanying diagrammatic drawings exemplifying the same and forming a part of the present disclosure.

In the drawings:

Figure 1 is a vertical sectional view of an improved gas producer constructed according to the invention, the section being taken along the line I—I of Fig. 2.

Figure 2 is a transverse sectional view taken along the irregular line II—II of Fig. 1.

Figure 3 is a fragmentary vertical sectional view on the line III—III of Fig. 4 showing another embodiment of the invention in the form of a calcium carbide furnace provided with valve-controlled flues having a more elaborate structure than those shown in Fig. 1.

Figure 4 is a sectional view along the line IV—IV of Fig. 3.

Figure 5 is a plan view of one of the improved flue devices.

The improved gas producer is preferably of the so-called open type but this involves no limitation so far as the invention is concerned.

The gas producer shown in the drawings comprises a shaft defined by an outer shell *s* having a cylindrical shape in its lower region and a frustum shape in its upper region, said shell being provided throughout its inner surface with a refractory laggging of substantial thickness. Such lagging is of uniform thickness at *a* along the lower part of the shell *s* and of gradually decreasing thickness at *b* in the upper part *o* of the shell to a line forming the extension of an outer flaring flange *n* defining a charging hopper on the open top of the shell.

The region of the lagging whose thickness gradually diminishes is hollowed at regular intervals as shown at *c* to provide outwardly and upwardly inclined flues having an outwardly decreasing cross sectional area. Such flues *c* communicate at one end with the annular mass *d* of materials undergoing reaction in the furnace and at the opposite end with upwardly projecting hollow cowls c^1 of uniform size whose open outer ends are closed by removable stoppers such as *j*. Each cowl c^1 is connected to one end of a downtake tube *t* provided with a valve *k*. The opposite end of each downtake tube *t* is connected to a ring-shaped collector or header *e* which surrounds the shell *s* at a certain distance from it. The collector *e* is connected to suction-creating means (not shown) of conventional structure such as a drawing fan.

Into the furnace space or shaft downwardly projects a stout electrode *g* axially bored at *f* to allow steam, carbon dioxide or another suitable vapor or gas to be injected into the subjacent space *i* inside the annular mass *d* of materials to be processed in the furnace.

The electrode *g* is conveniently connected to a suitable source of electric current. The voltage should advantageously vary between 25 and 45 volts depending upon the raw materials subjected to the treatment in the furnace.

The hearth or floor *h* of the furnace is made of a conductive substance, and the current which arrives through the electrode *g* flows over to said hearth across the annular reactive mass *d* which is either inherently conductive or rendered conductive by being electrothermically heated.

The gas or vapor injected through the electrode bore *f* reaches the space *i* whence it is distributed to the surrounding mass of materials *d* maintained at a suitable processing temperature by electrothermic action. The gases or vapors evolved by the reaction which then takes place percolate up through the annular mass *d* and are sucked through the flues *c* and header *e* and thence collected in suitable tanks (not shown). Before reaching such tanks, the gases or vapors

may be caused to flow through heat recuperators of conventional structure.

The annular mass d of reactive materials should be poked periodically by means of slice bars or similar tools so as to be kept in such proper state of porosity as will enable the gases or vapors to be evolved and to flow up towards the flues c. Such poking can be readily effected after having removed the stopper j from the cowl c^1 and closed the valve k so as to locally cut off the suction through the corresponding flue.

The raw materials m to be electrothermically processed in the furnace are charged either by hand tools or by power operated means into the flared upper mouth n of the top part o of the shell s so as to fill up the empty spaces which are created in proportion as the materials of the annular mass d are treated and crumble down. The production of flames can be checked or controlled by coordinating the injection of gas or vapor through the electrode bore f and the degree of suction through the collector e. Such a coordination may be achieved either by the operator's own control or by an automatic controller.

The molten material or slag which collects below the bored electrode g can be discharged periodically and at more or less frequent time intervals through a tap hole p and along a chute q which may lead down to any container (not shown).

A gas producer thus constructed may be used for converting carbon dioxide into carbon monoxide or for recovering carbon monoxide from processes involving the production of alloys or metallic carbides or else for extracting vapors of such metals as zinc or magnesium, also more generally for miscellaneous conversions or extractions of gases and vapors.

When dealing with gases that are chemically non-sensitive to heat influences and contain a small quantity of dust as for example sulphur dioxide from alkaline-earth sulphates, a simple flue connected to a header as in the above described construction is sufficient. Where, however, the gases are directly subjected to balancing reactions and become dust-laden owing to side reactions such as carbon monoxide resulting from the manufacture of calcium carbide or such metal vapors as are highly sensitive to oxidization and are difficult to condense as for example magnesia from magnesia-bearing carbonates, the simple flues as above described are no longer sufficient.

In such a case, it is necessary to incorporate with such dust-laden gases subjected to balancing reactions similar gases but in dust-freed and cooled condition so as to instantaneously lower their processing temperature to a value below the lower limit of the unbalancing range. In circulatory pipings, such incorporation of clean and cool gases permits the speed to be so increased as to prevent clogging due to premature dust settling.

Where metal vapors are subjected to the influence of carbon monoxide which is always present owing to the electrode operation, hydrogen should also be incorporated so as to dilute the vapors and lessen said influence and at the same time to cool them quickly enough to permit the condensed metal to be readily collected and to preclude choking of the pipes beyond the condensers.

Moreover, in all cases, care should be taken to lessen the entrainment of dusts other than those arising from certain reactions by broadening the operative range of slice bars or like poking tools on both sides of the suction pipes. The mass of materials being processed is thus kept sufficiently pervious so that when gently evolving therefrom, the metallic gases or vapors are practically devoid of impetus. This also greatly reduces air intakes through the charging hopper.

In view of the foregoing, experimental tests may lead to substituting for such simple flues as are shown in Figs. 1 and 2 the more intricate flues shown in Figs. 3 to 5 inclusive and associated with mixing valves. Such flues comprise on both sides of the suction orifices a pair of poking ports or holes formed in a relatively thin wall so as to permit the slice bars or like tools to be inclined to a greater degree while the poking operation is carried out.

In the construction shown in Figs. 3 to 5, **21** is the casing of a valve or cock made of cast iron and having water circulation or cooling ducts **2**. This casing **21** has a relatively thin flange **3** for the aforesaid purpose. This flange **3** rests on the upper part o of the furnace metal shell s to cover the flue c. Moreover, the casing **21** is provided with a pair of ports **4** (see Fig. 4) through which poking tools may be inserted and also with a pair of ducts **5**, **6**. The duct **5** is intended for the inflow of extraneous cold gases while the duct **6** serves for the outflow of the mixture of gases or vapors and extraneous gases, the mixing taking place in the valve.

The valve casing **21** is provided with a revoluble key **7** urged by a spring **8** abutted against the under face of a cap **9** towards a conical seat **10** which delineates an annular chamber **11** for the inflow of extraneous gases. A stub pipe **12** of elbowed outline cast integral with or otherwise rigidly fastened to the key **7** projects into the casing **21** and is adapted to simultaneously draw those cold extraneous gases which are sucked through the annular space **13** surrounding said pipe **12** and those hot gases or vapors that are sucked through the flue c and the inner end **14** of the valve casing **21**. The annular chamber **11** which girdles the pipe **12** communicates through an aperture **15** (see Fig. 4) with the duct **5** while the stub pipe **12** communicates through an aperture **16** with the duct **6**.

A V-shaped rotatable actuator **17** (see Fig. 5) makes it possible to simultaneously close off both ducts **5**, **6** and to release valve disks **18** fitted with counterweights **19** so as to enable such disks to unmask the poking ports **4**. These disks are locked between successive poking operations by being held down by the angularly bent ends **20** of the actuator arms **17**. Each counterweight **19** is supported by an arm **22** having a fulcrum pin **23** and a pivotal pin **24** by which the plane disk **18** is carried by said arm.

It will be understood that owing to the provision of such flues equipped with mixing valves or cocks, hot gases and vapors are instantaneously cooled by cold gases and the extraction of the gaseous mixture is interrupted while the poking ports are opened so as to prevent any undue air or gas intake during manipulation of the slice bars.

Therefore this improved arrangement of the flues and valves presents the following advantages over the more simple arrangement of flues c shown in Fig. 1. Firstly, an instantaneous cooling of the gases or vapors extracted from the reactive mass being treated is obtained. Secondly, greater gas masses are set into circulation, whereby higher speds are achieved which prevent any premature dust settlings. Thirdly, the stoppers or poking ports cannot be possibly

opened while the flues or valves are in normal operation and vice versa.

Flues built in this way are advantageously grouped into sets of four or five to match the capacity of volumetric suckers used and that of the gas producers involved in the plant. Extracted gases or vapors are sent to gasometers through condensers where the latter are required and, in all cases, through hydro-centrifugal or electrostatic dust removers.

The provision of dust removers is important because extracted gases always contain important propertions of dusts. Thus apart from lime arising from the disintegration of a portion of the calcium carbide at overheated points, carbon monoxide arising as by-product from calcium carbide contains nearly all the magnesia due to the action of carbon monoxide upon magnesium issued from substantially thorough reduction of magnesia present in raw materials undergoing treatment.

In the case of carbon monoxide resulting from the manufacture of calcium carbide, care should be taken to first eliminate raw materials having too high a content of magnesia and to operate from natural calcareous substance which, for the same quantity of calcium carbide, gives rise to a gas which is three times less laden with dust because its volume is three times as large.

In practical operation on a manufacturing scale, the electrode *g* may conveniently have a diameter equal to about four meters. In view of this, precautionary steps should be taken to protect the lower end of the electrode from the risk of breakage owing to its irregular nibbling to a so-called mushroom shape. It will be found by those skilled in the art that such steps can be easily determined whether when injecting steam or carbon dioxide or when the molten materials which collect upon the hearth *h* contain silica, manganeous oxide or metal carbides capable of being volatilised or disintegrated under service conditions. It will be found that vaporised water, carbon dioxide or vapors of silica, manganese oxide or metal carbides have the effect of whittling away the lower surface of the mass by a process of oxidization or decarburization. This, however, would cease to be the case where ordinary ashes replaced by magnesia and steam or carbon dioxide injections replaced by hydrogen injections.

So far as safety in the processing is concerned, atmospheric air cannot gain access to the sole gaseous pocket situated underneath the electrode *g* without previously flowing through the annular mass of reactive material *d* in which the oxygen contained therein is necessarily converted into carbon monoxide.

Any electric power up to 10,000 kilowatts may be used since an electrode having a diametrical size reaching four meters normally admits 400,000 amperes.

As regards suppleness of operation, and by way of analogy with frequent discontinuity as occurs when producing metallic carbide, in order to avoid any substantial loss of heat and undue nibbling of the electrode during off periods, it is only sufficient to cover the raw materials in the hopper with slack of a similar material as is current in the making of metallic carbide.

Moreover, as regards easiness of discharge of the ashes in the form of slags, clinkers or metal alloys, no greater difficulties are encountered than those exceptionally met when producing alloys or metallic carbides. Such difficulties can be always overcome by de-clogging the mass by striking an electric arc fed by current derived from the electrode input terminal.

Finally, as regards the adaptation of the process to all productions of alloys and metallic carbides which are accompanied by an evolution of carbon monoxide, it is obviously sufficient to substitute for carbonaceous material as used for the production of usual plant gas beds of molten material capable of giving rise to such alloys or metallic carbides.

As an exemplification of the way in which a furnace or gas producer according to the invention may be used, the following examples will now be given:

Example I

Where dealing with water gas according to the reaction

$$C+H_2O \rightarrow CO+H_2$$

28,800 calories (or 34 KWH) consumptions for 10,000 cubic meters and an electrothermic efficiency of 70% are as follows:

$$\text{KWH of reaction} = \frac{34}{44} \times 10{,}000 \times \frac{100}{70} = 11{,}040 \text{ KWH}$$

$$\text{Coke } 80\% \text{ of } C = \frac{12}{44} \times 10{,}000 \times \frac{100}{80} = 3{,}420 \text{ kilograms}$$

$$H_2O \text{ steam} = \frac{18}{44} \times 10{,}000 = 4{,}100 \text{ kilograms}$$

The relatively small quantity of FE—Si, 25% as by-product, permits the expenses to be covered as regards kilowatt-hours, coke and iron scrap consumption. Vaporization of the water is performed by recovering heat derived from a gaseous extraction conducted at 100° C. but due allowance should be made for the kilowatt-hours corresponding to the spent heat, namely

$$\frac{366}{864} \times 10{,}000 = 4{,}236 \text{ kilowatt-hours}$$

which for consumptions of 10,000 cubic meters of ($CO+H_2$) gives totals equal to

kilowatt-hours 15,276
coke 3,420 kilograms

and per cubic meter

1,6 kilowatt-hour
.35 kilogram of coke.

Example II

For carbon monoxide from residual carbon dioxide due for instance to decomposition of steam by carbon, consumptions for 10,000 cubic meters obtained by the following reaction

$$CO_2+C \rightarrow 2CO-38{,}800 \text{ calories (or 45 KWH)}$$

are as follows:

KWH of reaction:

$$\frac{45}{44} \times 10{,}000 \times \frac{100}{70} = 14{,}5[illegible]0 \text{ KWH}$$

$$\text{Coke } 80\% \text{ of } C\ \frac{12}{44} \times 10{,}000 \times \frac{100}{80} = 3{,}420 \text{ kilograms}$$

$$\text{Residual } CO_2\ \frac{44}{400} \times 10{,}000$$

1,000 kilograms or 2,000 cub. met.

$$\text{KWH for CO at } 1100° \text{ C.} \frac{366}{864} \times 10{,}000 = 4{,}236 \text{ KWH}$$

The totals for expensive consumptions of 10,000

cubic meters of carbon monoxide are therefore as follows:

KWH=18,816 KWH
Coke=3,420 kilograms

and per cubic meter

1.9 KWH
.35 kilogram of coke

Example III

With regard to CO resulting from the manufacture of calcium carbide according to the formula

$$CaO+3C=CaC+CO$$

to the extent of 275 cubic meters per ton of 80% carbide, the expensive super-consumption remains lower than the quantity of heat derived by the gas extracted at 1100° C. namely to:

$$\frac{366}{864}\times 275=117 \text{ kilowatt-hours}$$

or for one cubic meter .43 kilowatt-hour.

Example IV

For the same carbide from calcareous material and according to the formula

$$CaO \cdot CO+4C=CaC+CCO$$

leading to 825 cubic meters of Co per ton of 80% carbide, the super-consumption only relates to the kilowatt-hours since the fourth atom of carbon substantially corresponds to that quantity of coke which would be used up for producing quick lime.

However, to the super-consumption which is three times as large for heat derived from an extraction of carbon monoxide which is also three times as large, namely 351 KWH, there must be added the one following the decomposition of 1600 kilograms of calcareous substance, namely

$$\frac{42{,}500}{864}\times\frac{1600}{100}=787 \text{ KWH}$$

as well as the one following the conversion of CO_2 into 2CO namely:

$$\frac{45}{44}\times 550\times\frac{100}{70}=803 \text{ KWH}$$

making a total for each ton of 80% carbide of

$$351+787+803=1941 \text{ KWH}$$

or reckoned per cubic meter

$$\frac{1941}{825}=2.36 \text{ KWH}$$

It will be understood that the extraction method using downdraft or, in other words, inverted draft in the improved gas producer according to the invention is the only one which permits a complete reduction of CO_2 from calcareous substance to be achieved.

Example V

Assuming now 45% ferro-silicon to be dealt with according to the following formula

$$SiO_2+2C=Si+2CO$$

which leads to

$$\frac{44}{28}\times 450=707 \text{ cubic meters}$$

of carbon monoxide per ton of alloy obtained, the expensive super-consumption is reduced, as for calcium carbide, from quick lime, to the heat derived by the carbon monoxide extracted at 1100° C. that is to say to

$$\frac{366}{864}\times 707=300 \text{ KWH}$$

or per cubic meter

$$\frac{300}{707}=.43 \text{ KWH}$$

It will be understood that the foregoing examples are not to be construed in too rigorous a sense and, moreover, that they are not limitative. The electrothermic gas producer according to the invention is also suitable for the extraction of metallic vapors such as zinc or magnesium vapors or other so-called industrial gases. It thus becomes possible to instantaneously determine the advantages which can be derived depending upon circumstances and contemplated productions. These advantages can be obtained with none of the formerly devised electrothermic appliances which were lacking in reliability, safety, operational flexibility and easiness of adaptation.

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Fig.1

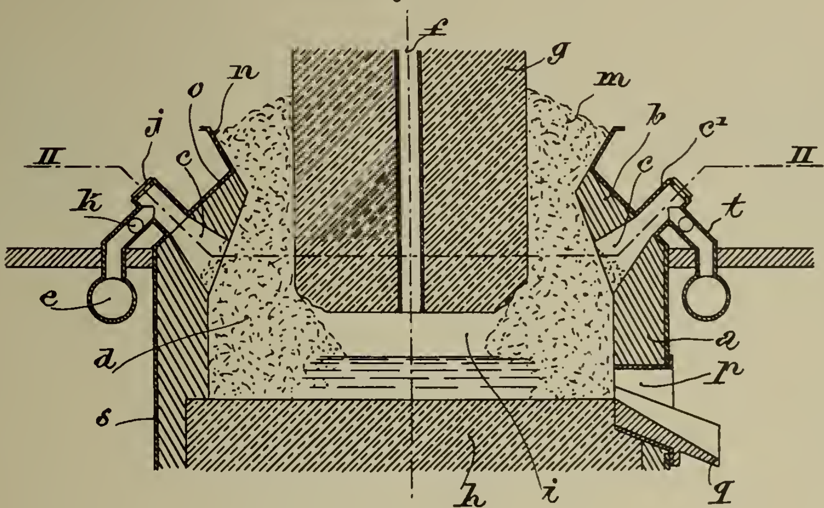

Fig.2

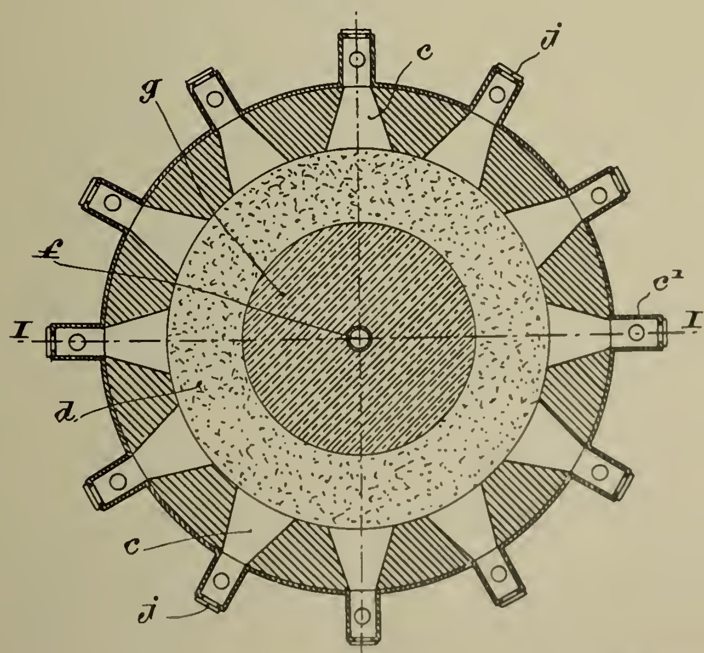

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Fig. 4

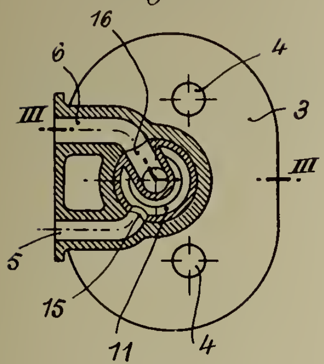


Fig. 3

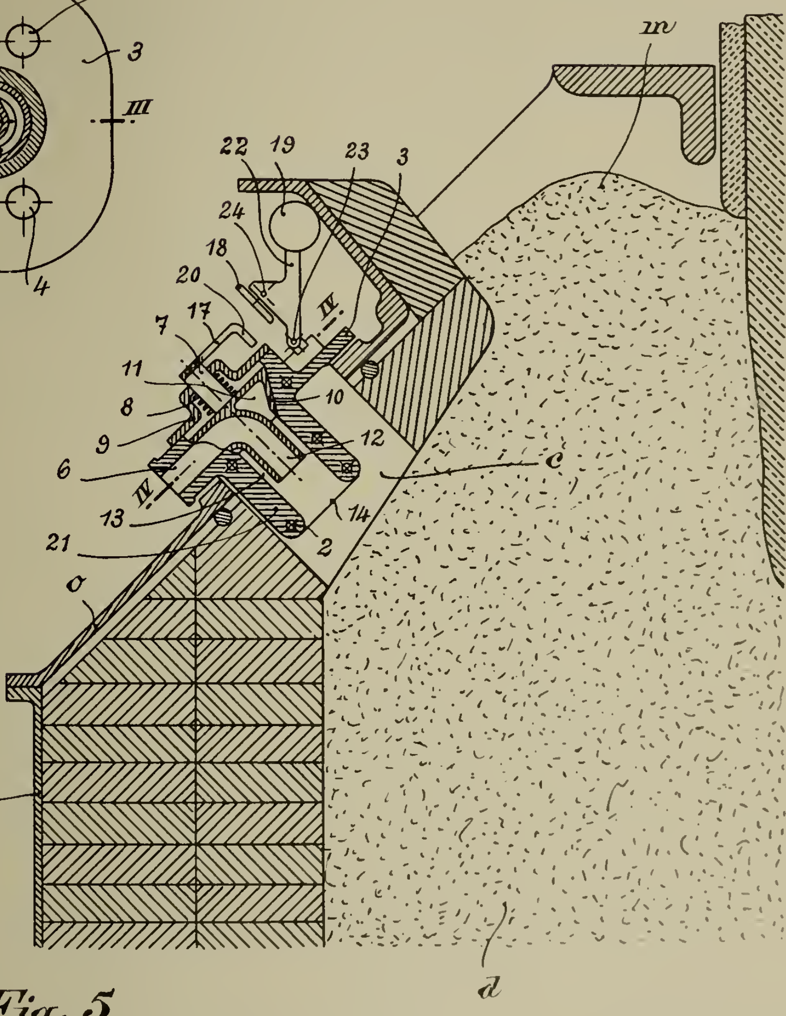
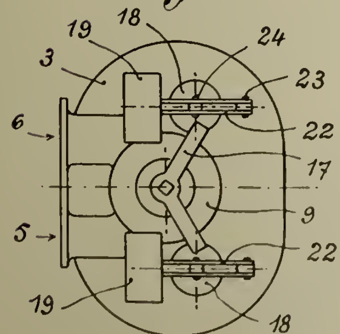


Fig. 5



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ALIEN PROPERTY CUSTODIAN

FLUID OPERATED POWER TRANSMITTER

Wincenty Jastrzebski, Aix-les-Bains, France; vested in the Alien Property Custodian

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Hydraulic change speed gears are already known wherein the change of gear ratio from a driving shaft to a driven shaft is obtained by increasing or decreasing the quantity of a liquid forced by a pump operatively connected to one of said shafts and derived from another pump operatively connected to the other shaft. With such a structure, when it is desired to increase the speed of the driven shaft, a larger quantity of liquid must be displaced from one pump into the other.

It is an object of the present invention to provide as an improvement and development of the aforesaid type of hydraulic change speed gear a novel fluid operated apparatus utilisable as a power transmitter either for imparting to a driven shaft selectively any one of an unlimited number of different speeds from a driving shaft or else as a change speed power transmitter permitting the impulse from a driving shaft to be imparted without any substantial loss of energy to a driven shaft with several different gearing ratii and also a reverse drive to be obtained.

Another object of the invention is to provide a power transmitter utilisable for miscellaneous purposes whenever the speed of a driven mechanical member requires to be varied and having a simple structure ensuring an inexpensive operation because it functions by controlling a member which regulates the circulation of a liquid such as oil filling the transmitter chamber capacity, said circulation resulting from the resistance which checks the motion of the driven shaft with respect to the motion to be imparted thereto by the driving shaft, to each reduction of the mass of circulating liquid corresponding an increase of the driven shaft speed, i. e. a decrease of the ratio between the respective speeds of both shafts.

Yet another object of the invention is more specifically to provide an oil operated power transmitter comprising a pair of revoluble coaxial elements movable with respect to each other and so interengaged as to delineate chambers whose total volume is constant while their partial volumes vary when one of said elements is moved with respect to the other responsive to varying resistances, said power transmitter enabling a number of different rates of speed to be imparted to a driven shaft from a driving shaft revolving at uniform speed.

A further object of the invention is to provide a novel fluid operated power transmitter as aforesaid made up of a small number of simple and rugged members awarding the entire structure good operating conditions and proper durability.

A still further object of the invention is to provide a novel fluid operated power transmitter as aforesaid having a better kinetic efficiency than similar fluid operated appliances devised heretofore and so constructed as to permit a direct drive transmission without any relative displacement of members and without any liquid (oil) circulation.

With these and such other objects in view as will incidentally appear hereafter, the invention comprises more particularly the novel construction, combination and arrangements of parts that will be now described in detail with reference to the accompanying diagrammatic sheets of drawings exemplifying several embodiments of the same and forming a part of the present disclosure.

In the drawings:

Figure 1 is a plan view of the entire power transmitter, assuming the semi-circular wall to have been removed for the sake of clearness.

Figure 2 is a sectional view on the line 2—2 of Fig. 3, assuming one of the shafts to have been rotated by 180° with respect to the other shaft.

Figure 3 is a transverse sectional view on the line 3—3 of Fig. 2.

Figure 4 is a fragmentary sectional view on the line 4—4 of Fig. 3, assuming the set of movable partitions to be omitted.

Figures 5 and 6 are respectively an end view and a top plan view of a set of movable partitions.

Figure 7 is a longitudinal sectional view on the line 7—7 of Fig. 8 showing a modified construction of the transmitter.

Fig. 8 is a transverse sectional view on the line 8—8 of Fig. 7.

Figures 9 and 10 are respectively a top plan view and an elevational view of the movable partition embodied in the modified construction shown in Fig. 7.

Figure 11 is a longitudinal sectional view on the line 11—11 of Figs. 12, 13, 14 and 15 of a power transmitter forming an entire gear box according to the invention.

Figures 12, 13, 14 and 15 are respectively transverse sectional views along lines 12—12, 13—13, 14—14 and 15—15 of Fig. 11, showing the members included in the section planes, those situated rearwardly in other planes being omitted.

Figures 16a, 16b and 16c are views of the cylindrical valve shown respectively in longitudinal elevation with a section through the casing, as-

suming the casing to be omitted and after a rotation of 90° about its axis and in section along the line 16a—16a of Fig. 16b.

Figures 17, 18 and 19 are views of the movable partition which is visible in Fig. 15 shown respectively in elevational, end and top plan views.

Figures 20a, 21a, 22a, 23a, 20b, 21b, 22b and 23b are transverse sectional views of the cylindrical valve taken respectively along the lines 20a—20a, 21a—21a, 22a—22a, 23a—23a, 20b—20b, 21b—21b, 22b—22b and 23b—23b of Fig. 11 in positions corresponding to the line 12—12 of Fig. 11 for the sections bearing the reference *a* and to the line 15—15 of Fig. 11 for the sections bearing the reference *b*, said positions being occupied after such displacements as are effected to provide idle run, first speed, second speed and reverse respectively.

Figure 24 is an explanatory view setting forth the operation of the power transmitter resulting from the superposition of the sectional views shown by Figs. 12 and 15.

Figure 25 is a longitudinal sectional view of a further constructional modification of a power transmitter according to the invention.

Figures 26, 27 and 28 are transverse sectional views respectively taken along lines 26—26, 27—27 and 28—28 of Fig. 25.

Figure 29 is a separate view of the cylindrical valve, its casing being shown in section.

Figures 30, 31 and 32 are views of the movable partition visible in Fig. 27 taken respectively in end view, in top plan view and in lower plan view.

Figures 33a, 34a, 35a, 36a, 33b, 34b, 35b, 36b, 37a and 37b are transverse sectional views of the cylindrical valve taken respectively along the lines 33a—33a, 34a—34a, 35a—35a, 36a—36a, 37a—37a, 33b—33b, 34b—34b, 35b—35b, 36b—36b and 37b—37b of Fig. 25 in the positions corresponding to 26—26 of said figure for sections referenced by *a* and to 27—27 of the same figure for sections referenced by *b*, such positions being those assumed after the displacements effected to obtain the idle run, the first speed, the second speed, the third speed and the reverse respectively.

Figure 38 is a diagrammatic isometric view showing an essential part of the power transmitter according to the invention.

Figure 39 is an explanatory diagram facilitating proper understanding of the power transmitter operation.

As illustrated, the change speed power transmitter is interposed between a shaft 2 (Figs. 1, 2 and 38) which may be and will be termed hereafter a driving shaft and a shaft 5 which may be and will be termed hereafter a driven shaft. Said shaft 5 has a stub extension 7 which projects into a chamber 8 defined in a peripherally cylindrical casing 9 rigid with the driving shaft 2. The end surfaces of said chamber are constituted by a pair of plates 10, 11 forming the end closures of the casing 9. The inner surfaces of the plates 10, 11 have arcuate sinusoidal outlines substantially as shown in Fig. 39 and extend in parallelism.

A surface having such an arcuate outline is generated by a straight line such as *ab* extending at right angles to the axis of the shaft 2 (Fig. 1) and to which is imparted lengthwise of said axis a sinusoidal motion whose amplitude bears a certain ratio with the extreme degree of unevenness of the plate surface.

Between the sinusoidally undulated surfaces of the plates 10, 11 is slidably interposed a partition comprising a single element 12 parallel to the generatrix *ab* or a pair of juxtaposed elements 12a, 12b (Figs. 1, 5 and 6). Said partition is adapted alternatively to slide between said undulated plates while providing a fluid-tight seal between them and also between the casing 9 and the driven shaft 5.

The driven shaft 5 carries a circular disk-shaped divider 13 having a thickness equal to the interval (Fig. 38) between planes at right angles to its axis and tangent to the crests or uppermost points of the undulated surfaces of the plates 10, 11. The disk 13 provides fluid tightness along its lines of contact and splits the chamber 8 into a pair of compartments. Said disk 13 has a radial notch 14 in which is snugly received the partition 12 which is freely slidable therein parallel to the axis of the driven shaft 5 and divides in turn each compartment into a pair of sub-compartments.

Communication is provided between both faces 15, 16 of the partition 12 by channels 17, 18, 19, 20 in the disk 13. The circulation of the fluid through said channels may be throttled and, if required, fully closed off by operating primary valve means such as a cock 21 which is movably housed in a central recess 22 parallel to the axis of the driven shaft 5 and separates the channels 18, 19 from each other.

The operation of the power transmitter will be clearly understood from Fig. 39. An examination of this diagram shows that the sub-compartments 51, 52 defined on opposite sides of the disk 13 and to the right of the partition 12 communicate through a port 53 formed in the right hand face of said partition while the sub-compartments 54, 55 also defined on opposite sides of the disk 13 but to the left of the partition 12 similarly communicate with each other through a port 56 formed in the left hand face of said partition. The longitudinal ports 53, 56 are interconnected by a transverse port 59 whose sectional area is controlled by secondary valve means such as a cock 61.

Assuming the shaft 2 to rotatably drive the plates 10, 11 in the direction indicated by the arrow 23, it will be understood that the action of their undulated surfaces tends to reduce the volume of the sub-compartments 51, 52 in proportion as their lines of contact 57, 58 with the disk 13 are moved toward the partition 12. This reduction of volume is obviously accompanied by an increase of pressure of the fluid which fills said sub-compartments and which has a tendency to leak out through the ports 53, 59 and 56 into the sub-compartments 54, 55 whose volume gradually increases exactly in terms of the extent of gradual reduction of the volume of the sub-compartments 51, 52.

Assuming all the sub-compartments to be filled with oil or an equivalent liquid, a circulatory motion is imparted to the oil in the direction shown by the arrow 24 (Fig. 3) from the sub-compartments situated on one side of the partition 12 to those situated on the opposite side.

If now by means of the cock 61 (Fig. 39) the port 59 is fully closed, the flow of oil is intercepted therethrough. As a result of this, there is created inside the sub-compartments 51, 52 an oil overpressure which at once reacts against the partition 12 and sets it into motion. This partition is therefore moved and drives with it the disk 13 at a speed equal to that of the plates 10, 11. Should now the port 59 be only partly closed by the cock 61, the oil circulation from the chambers 51, 52 toward the chambers 54, 55 is merely slowed down, this resulting in a rotary

sliding motion of the disk 13 with respect to the plates 10, 11.

In the constructional form shown in Figs. 1 to 3, the passage of the fluid from the disk channel 18 to the disk channel 19 is closed off by shifting the cock 21 in the direction shown by the arrow 25 (Fig. 2).

In order to permit the rotary motion of the driven shaft to be further transmitted, said shaft may be furnished with a pulley or any other suitable contrivance of conventional form (not shown).

Should the mouth 27 of the disk channel 19 be fully closed off, the driven shaft 5 will revolve as fast as the driving shaft 2. In such case, direct drive may be obtained by bringing claws 28 splined on the driven shaft 5 (Fig. 2) into meshing engagement with the spaces between claws formed integral with the plate 11 rigidly connected to the driving shaft 2.

Where, however, the mouth 27 of the disk channel 19 is only partly closed, the oil can flow therethrough slowly on account of the resulting overpressure against the face 16 of the partition 12, whereby the latter is moved and drives with it the shaft 5 but at a speed lower than that of the driving shaft 2.

The resultant rotary sliding action is the larger as the flow of oil is less slowed down. This enables an unlimited number of transmission ratii to be readily obtained in a most simple way.

In the modified constructional form shown in Figs. 7 to 10, the driving shaft 2 is secured to a pair of semi-circular shell members 31, 32 having facing surfaces so cut as to form walls between which is movably arranged a sector-shaped partition 33 to which an oscillatory motion is imparted with respect to the central port 34. The power transmitter assembly thus built up forms a change speed gear box whose operation is substantially the same as that of the first constructional form as above described.

There is also shown in Fig. 7 a reversing gear adapted to operate owing to the bringing of a shiftable pinion 35 into mesh with either of a pair of dog pinions 36, 37, the pinion 37 being rigidly secured to a bevel pinion 38 driven by another bevel pinion 39 through an intermediate bevel pinion 40.

This power transmitter enables the ratio of the speeds of the two shafts which it intercouples to be changed. However, it does not fully transmit the input power.

In contradistinction to this, a change speed gear box embodying the power transmitter according to the invention and as shown in Figs. 11 to 24 possesses the speed changing characteristics as above described and is adapted, moreover, to fully transmit the input power when the speeds of the driving and driven shafts are in inverse ratio to the capacities of the two chambers connected to the respective shafts.

The power transmitter shown in Fig. 11 is made up of a pair of chambers 64, 65 having arcuate walls and different capacities, mounted for rotation on a tubular shaft 66 and having intercommunication as will be described hereafter.

The smaller chamber 64 is defined by a pair of shell members 67, 68 having walls so cut as to present undulated faces between which is arranged a sector-shaped partition 69 movable parallel to the axis of said chamber 64 and to which is imparted an oscillatory motion relative to the chamber center. Such partition 69 which ensures fluid tightness between the chamber walls is housed in a recess provided to that effect in a disk 70 rigidly carried by the tubular shaft 66 and revolubly housed in the chamber 64.

Inside the larger chamber 65 defined by the two shell members 71, 72 are accommodated a disk 73 and a partition 106 movably arranged between walls similar to those of the chamber 64.

Inside the tubular shaft 66 is housed for longitudinal motion a cylindrical valve 74 which enables the rate of flow of the liquid between the compartments of one and the same chamber or of a pair of different chambers as well as the direction of circulation of the liquid between the large chamber compartment to be adjusted.

In order to bring the cylindrical valve 74 to the different positions corresponding to idle run, low gear ratio, high gear ratio and reverse run, the displacement of said valve 74 is controlled by a rod 75 fixed by a key 76 to a ring 77 slidably mounted on the driven shaft 78.

Where the power transmitter is used as a change speed gear on a vehicle, the smaller chamber 64 of the transmitter unit is coupled at the left hand side end with the power or driving shaft 79 while its larger chamber is coupled at the right hand side end with the driven shaft 78.

Should the engine of the vehicle be started while the cylindrical valve 74 is in the position shown in Fig. 11, the vehicle cannot be set into motion because inside the chamber 64 which rotates together with the driving shaft 79 the liquid freely circulates from one face to the other face of the movable partition 69 through the channel 80 of the cylindrical valve 74 (Fig. 12) and through channels 81, 82 formed in the disk 70 which remains stationary.

Assuming now the toothed annular shell 83 of the bevel clutch 84 to be pushed in the direction shown by the arrow 85 through the toothed disk 86 (Fig. 11) keyed to the tubular shaft 66 and said shaft to be held motionless with respect to the frame 87 of the apparatus and assuming furthermore the cylindrical valve 74 to be moved in a direction opposite to that shown by the arrow 85 so as progressively to close off direct flow of the liquid through the smaller chamber 64, the liquid circulation will be set up from the smaller chamber 64 toward the larger chamber 65 through the side channels 88, 89 (Fig. 15) in the valve 74. The path followed by the liquid will be therefore as follows: Channel 81 in disk 70 (Fig. 24), side channel 88 in valve 74, channel 90 in disk 73 (Fig. 15), chamber 65, channel 91 in disk 73, channel 89 in valve 74, and channel 82 in disk 70.

Owing to the reactive stress exerted by the liquid against the walls of the chamber 65 whose casing is mounted upon the driven shaft 78, the vehicle will be started and will take up a speed which will increase at the same time as the rate of flow between the chambers 64 and 65, i. e. at the same time as the relative speeds between larger chamber 65 and smaller chamber 64

Should the cylindrical valve 74 be so moved as to cause the port 92 (Fig. 11) to replace the port 80 and to establish communication with the channels 81, 82 in the disk 70, direct communication of the liquid through the smaller chamber 64 will be cut off. The full quantity of liquid will flow through the larger chamber 65 owing to the provision of the side channels 88, 89 and will impart thereto a motion whose speed will be in inverse ratio of the relative capacities of both chambers 64, 65.

It will be noticed that owing to the larger radius and the larger pressure surface in the larger

chamber 69, the energy is transmitted without any substantial loss.

In order to further increase the speed of the chamber 65, the driven shaft 78 may be freed by shifting the bevel gear in a direction reverse of that of the arrow 85 and the cylindrical valve 74 may be further moved in the same direction. When the side ports 93, 94 are no longer opposite the respective ports of the channels 90, 91 (Figs. 15 and 22) in the disk 73, the liquid flow is cut off intermediate the chambers 64, 65.

After the liquid flow has thus been cut off, both chambers 64, 65 and the tubular shaft 66 revolve at the same speed. By moving the clutch gear 83 in a direction reverse to that shown by the arrow 85, a direct drive is secured since owing to the intermeshing of the gears 95, 96 the toothed wheels 97, 98 respectively connected to the driving shaft 79 and the driven shaft 78 are coupled up. At that moment, the liquid pressure inside the chambers is equal to zero.

In order to obtain a reverse drive, the cylindrical valve 74 must be moved in the direction shown by the arrow 85 until the ports 99, 100 assume (as viewed in Fig. 11) the position of the channel 90. The clutch 83 should be moved in the same direction to connect up the tubular shaft 66 of the frame 87.

When the port 99 coincides with the channel 81 in the disk 70, the liquid flows through the slanting channel 101 toward the side channel 89 formed in the opposite face of the cylindrical valve 74. Conversely the channel 101 is set into communication with the other side channel 88 through the other slanting channel 102. The direction of the liquid flow through the chamber 65 is therefore reverse to its previous direction of flow. This change of flow direction involves a change in the direction of revolution of the chamber 65 with respect to its previous direction of revolution. The reverse drive of the vehicle fitted with such a power transmitter is thus obtained.

Assuming the cylindrical valve 74 to occupy the position shown in Fig. 11 (idle run position) and said valve to be brought to the position corresponding for example to the lower gear ratio and assuming, moreover, the driving shaft 79 to revolve in the direction shown by the arrow 103 (Fig. 24) the smaller chamber 64 will rotate in the same direction. As pressure prevails in the channels 81, 88, 90, the larger chamber is driven in the same direction.

Should now the cylindrical valve 74 be so moved as to bring the ports 99, 100 to the locations occupied by those of the channel 80, the pressure will prevail in the channels 81, 89, 91 and the larger chamber will revolve in the direction indicated by the arrow 104.

It will be seen that the twin chamber change gear power transmitter as above described enables an unlimited number of gearing ratii to be obtained during which the powers of the driving and driven shafts are proportional to the speeds of said shafts. Moreover, said transmitter permits two gearing ratii, i. e. two rates of speed to be secured, namely a direct drive, and a drive which is inversely proportional to the capacity of the two chambers.

The constructional modification shown in Figs. 25 to 37 is based on the same operational principle and is adapted to fully transmit the power received for three set rates of speed and to obtain an unlimited number of gearing ratii but with a decrease in the power.

In this constructional modification of the power transmitter there are provided a smaller chamber 120 and a larger double chamber 121. The capacity of said larger chamber is split into a pair of compartments by a partition 122 held stationary by securing means such as dowel pins 123.

In the compartment 124 are revolubly arranged a disk 125 and its movable partition 126 while in the other compartment 127 are revolubly arranged a disk 128 and its movable partition 129. These two disks are rigidly connected to a tubular shaft 130 in which is movably housed a cylindrical valve 131. As shown in Fig. 29, said valve comprises a sleeve 131 surrounding a core 133 having a port 134 for idle running conditions and more or less elongated grooves providing direct or reverse communication between the compartment 135 in the smaller chamber 120 and the compartments 124, 127 in the larger chamber 121. The channels 136, 137 facing the larger chamber have a particularly elongated shape as well as those 138, 139 in front of which are the ends of the channels 140, 141 in the disk 142 which drives the movable partition 147.

The channels 143, 144 establish communication between the compartments defined in the smaller and larger chambers as shown in each particular instance by the detailed Figures 33*a*, 33*b* to 37*a* and 37*b*.

A power transmitter thus constructed is also provided with a conical toothed wheel 145 whose axial displacement provides or fails to provide a connection between the chambers 120, 121 and the toothed annular wheel 146 secured to the shaft 130.

When shifting the cylindrical valve 131 to match requirements, a flow of liquid is established between the smaller chamber 120 and the two compartments 124, 127 of the larger chamber 121 or else such flow is reduced to the flow between the smaller chamber 120 and one compartment of the larger chamber 121. The partitioning of the larger chamber into a pair of compartments permits three gear ratii to be obtained and a full transmission of the input power to be secured. Such gear ratii are as follows: Firstly, a direct drive. Secondly, a gear ratio which is in inverse terms of the capacity of the chambers 120, 121. Thirdly, a gear ratio which is in inverse terms of the capacity of the smaller chamber 120 with respect to that of one of the compartments in the larger chamber 121.

The operation of this power transmitter is substantially the same as the one of the transmitter shown in Figs. 11 to 24 with the exception that during operation with the upper gear ratio the extreme compartment 127 of the larger chamber 121 does not operate.

It will be understood that in order to obtain the upper gear ratio, the cylindrical valve 131 must be so shifted as to bring the line 35*a*—35*a* of Fig. 25 to the location of the line 33*a*—33*a*. The end 132 of said valve then entirely projects from the port of the channels 132, 153 in the outermost disk 128 of the larger chamber 121 and does away with any communication between the smaller chamber 120 and the compartment 127 in said larger chamber.

Such a motion imparted to the cylindrical valve 131 provides a direct communication between both faces of the movable partition 129 defining the compartment 127 so that the liquid therein flows without producing any effect as in the smaller chamber 120 during idle run,

Therefore the capacity of the larger chamber **121** is reduced as it were by comparison with the capacity of the smaller chamber **120**. The speed of the driven shaft is consequently enhanced.

It will be seen that a power transmitter as above described enables the several objects of the invention to be fulfilled and particularly the following results to be obtained, namely:

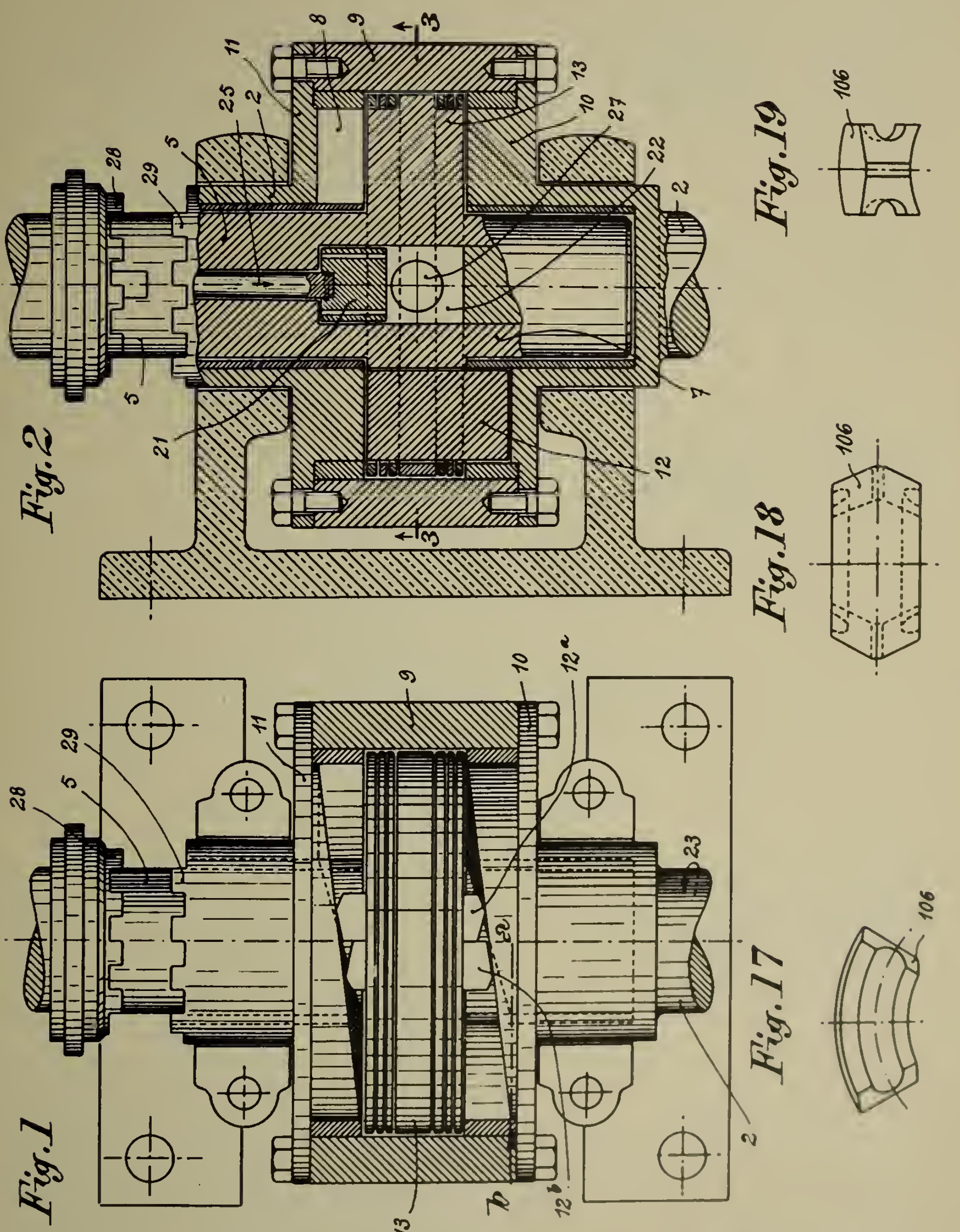
(*a*) an unlimited number of transmission ratii between a driving shaft and a driven shaft;

(*b*) three different rates of speed or transmission ratii without any reduction of power;

(*c*) a selective reverse in the direction of rotation.

WINCENTY JASTRZEBSKI.

PUBLISHED	W. JASTRZEBSKI	Serial No.
JUNE 1, 1943.	FLUID OPERATED POWER TRANSMITTER	459,260
BY A. P. C.	Filed Sept. 22, 1942	7 Sheets-Sheet 1



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PUBLISHED
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FLUID OPERATED POWER TRANSMITTER
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459,260
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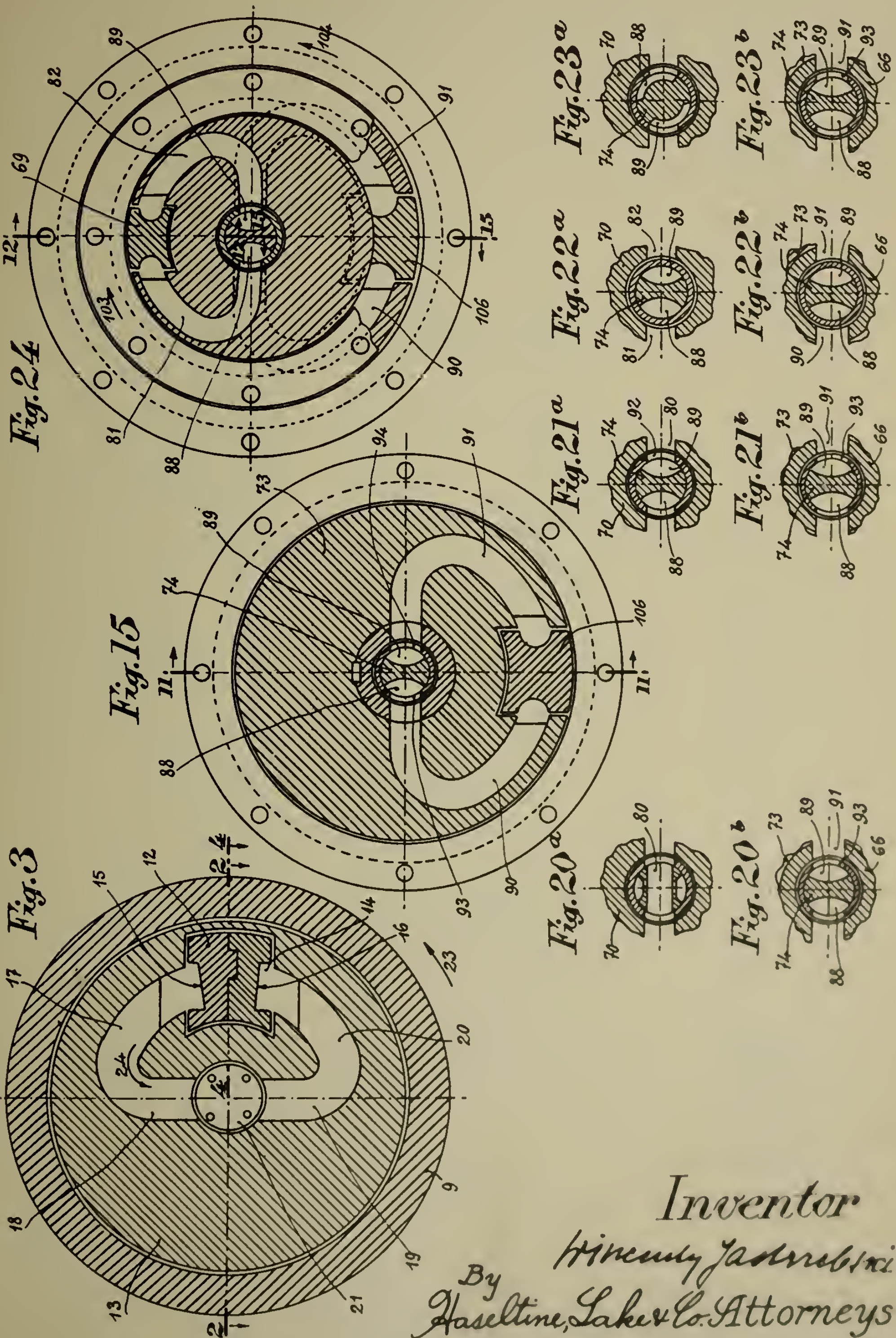

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PUBLISHED	W. JASTRZEBSKI	**Serial No.**
JUNE 1, 1943.	FLUID OPERATED POWER TRANSMITTER	**459,260**
BY A. P. C.	Filed Sept. 22, 1942	7 Sheets-Sheet 3

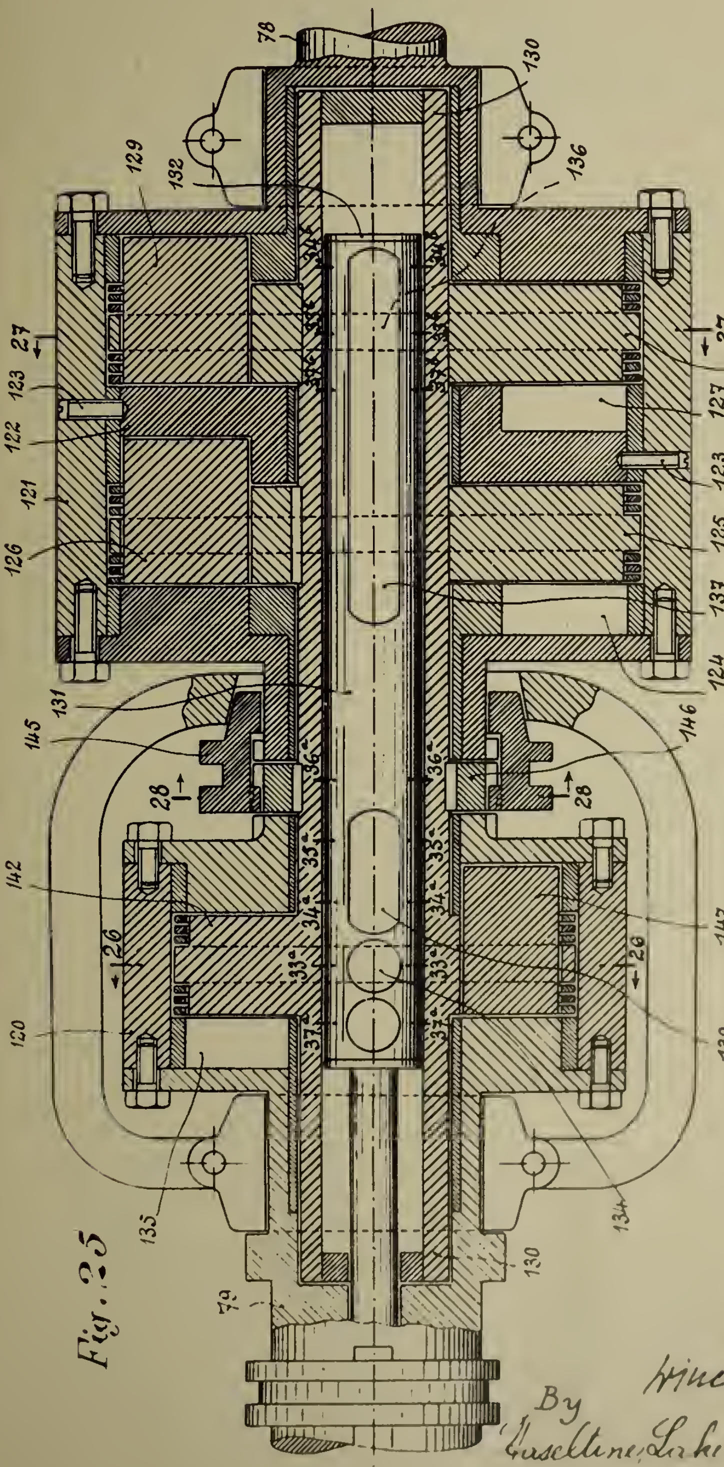

Fig. 25

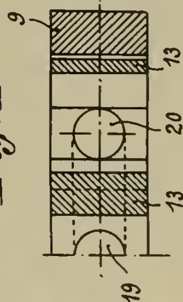

Fig. 4

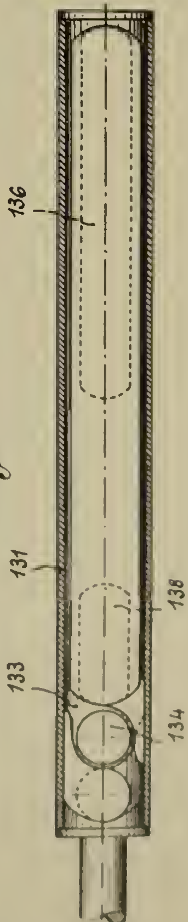

Fig. 29

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Fig. 38

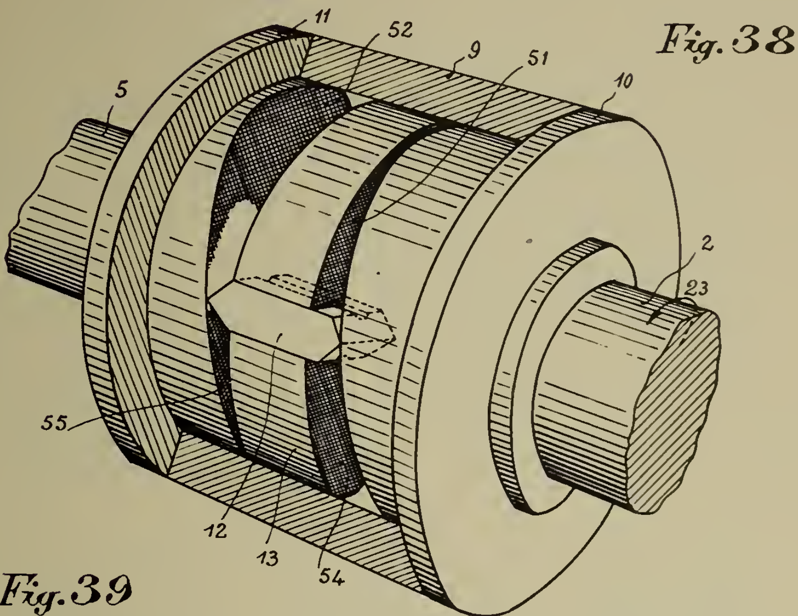

Fig. 39

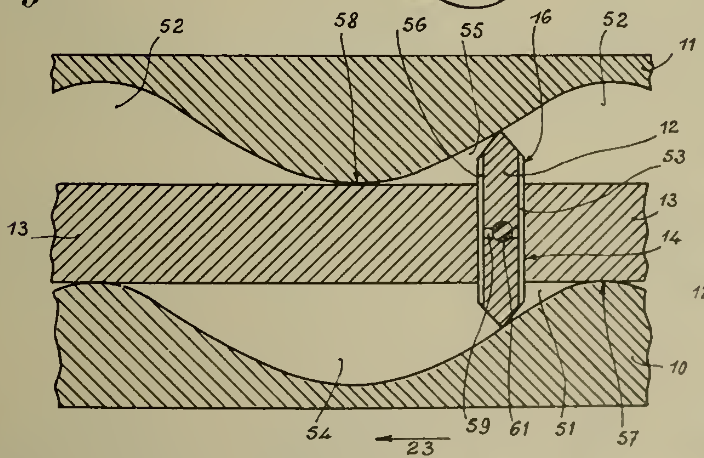

Fig. 5

Fig. 6

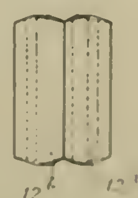

Fig. 30

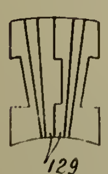

Fig. 31

Fig. 32

Fig. 9

Fig. 10

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Attorneys

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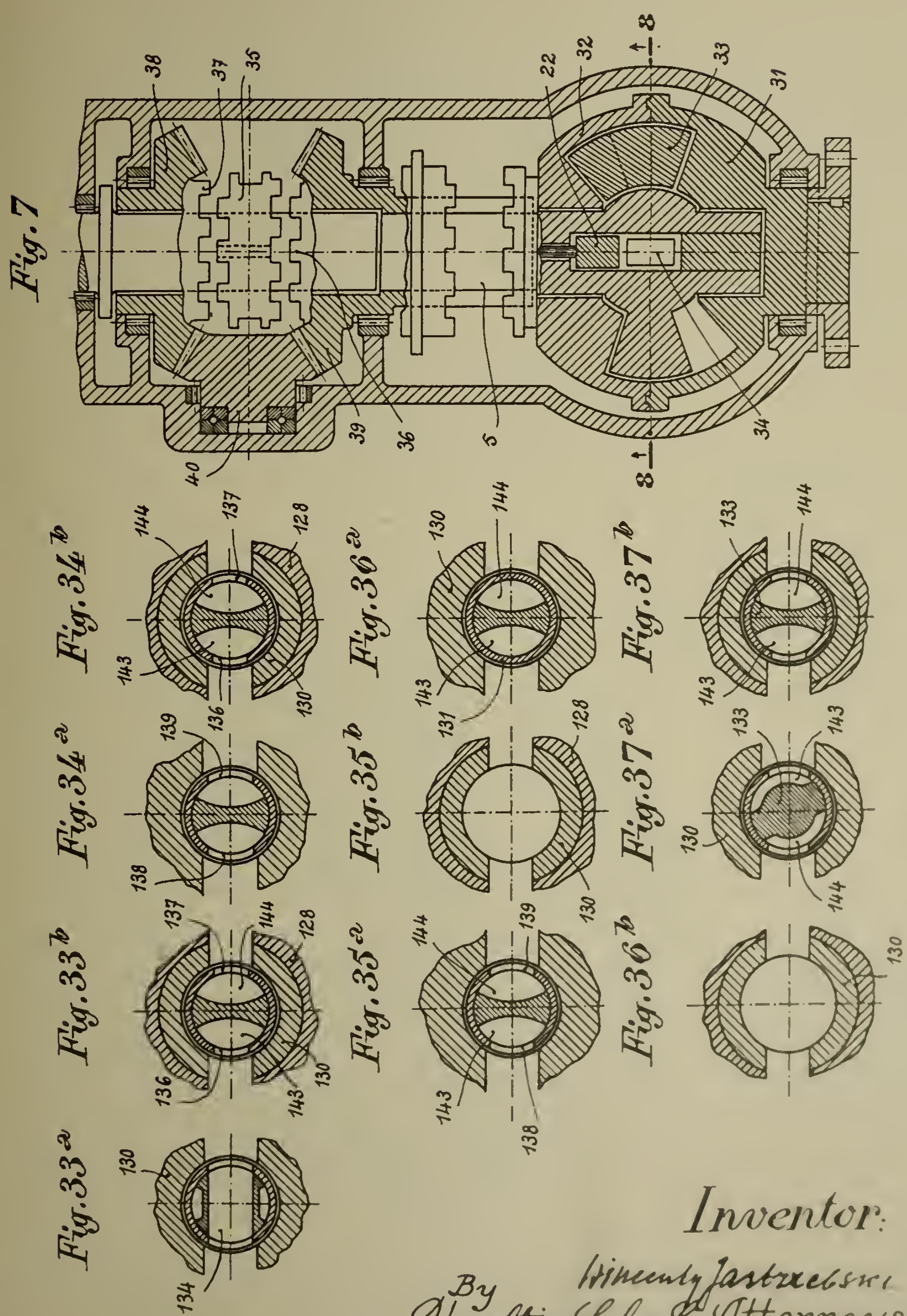

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Fig. 26

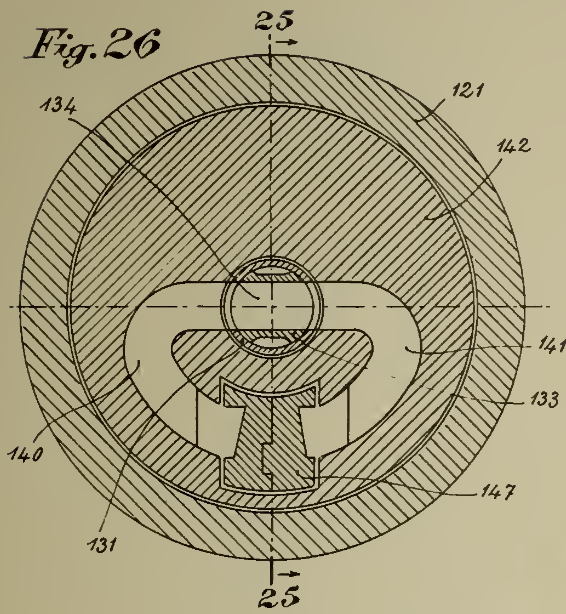


Fig. 28

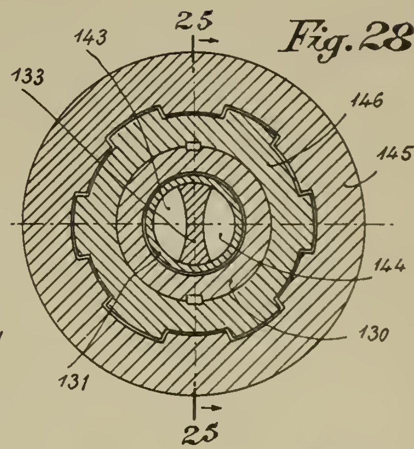


Fig. 8

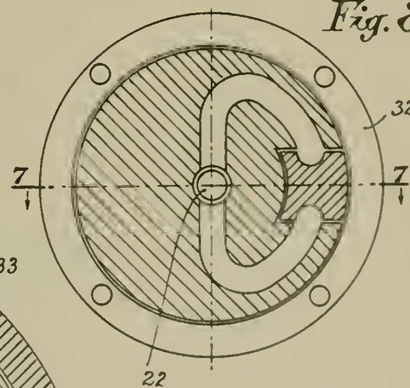


Fig. 27

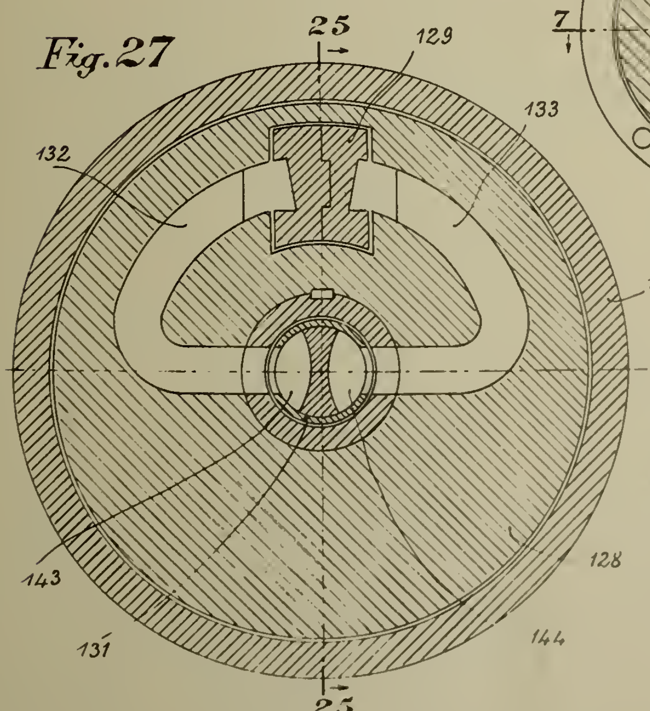
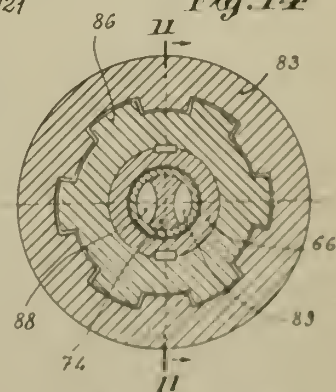


Fig. 14



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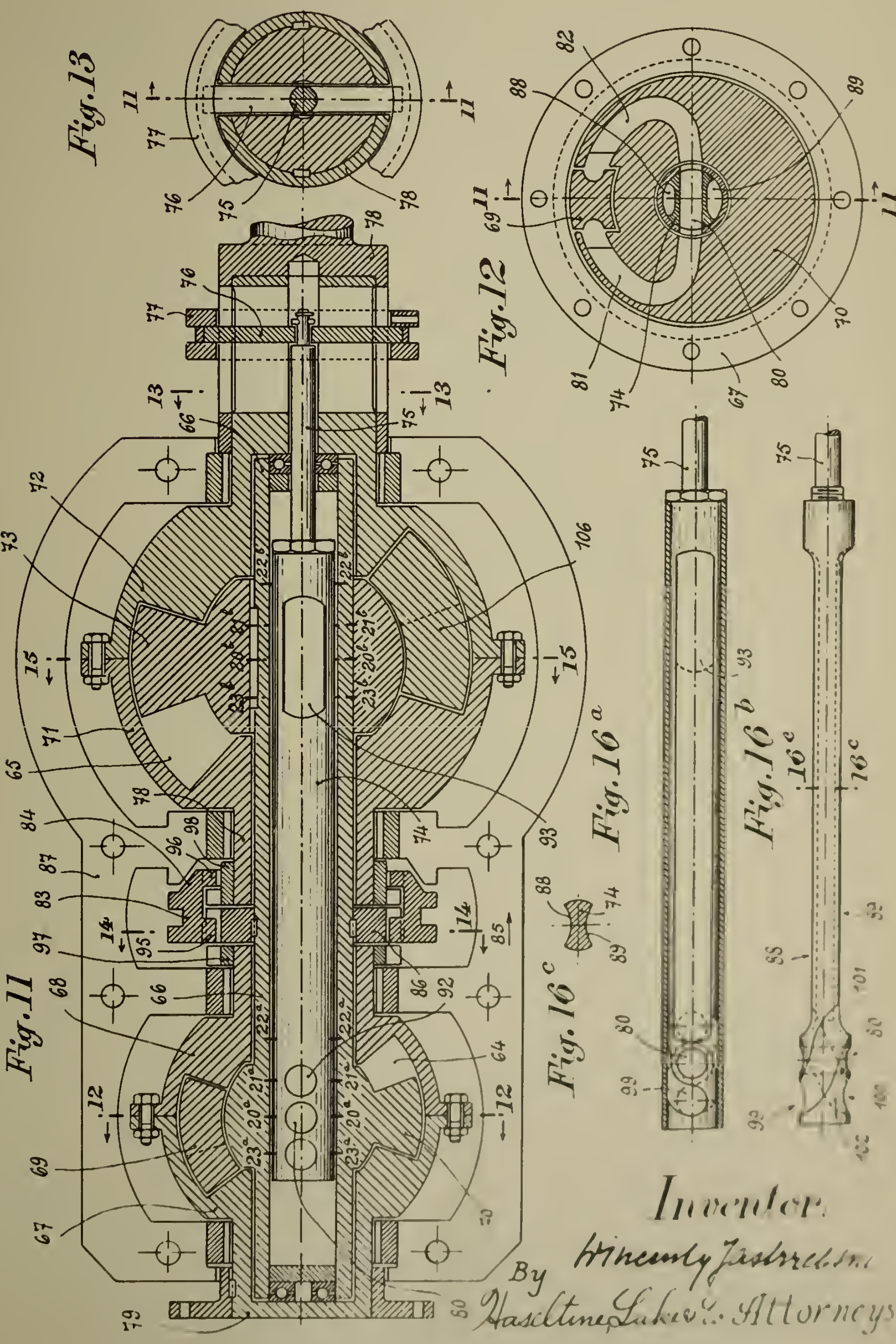

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ALIEN PROPERTY CUSTODIAN

HAND KNITTING NEEDLE

Henriette Fosse, Jean Palou and Louis Lacombe, Avignon, France; vested in the Alien Property Custodian

Application filed September 22, 1942

As is known, anyone engaged in hand knitting work to produce hosiery articles such as socks, sweaters or bodices should vary the number, shape and arrangement of the stitches to suit the particular interknitting process, the number and shades of mesh rows and wales that are called for by any given category of knitted article so far as length, width, decreases of size, skew arrangements of meshes and similar factors are concerned. In view of this, the person who is knitting must often stop her work and take measures or make calculations, this being usually done by means of a tape measure, lest the proper number of meshes to be knitted is exceeded and must be undone and afterwards re-knitted. All such disadvantages involve an important waste of time and curtail the amount of knitting work which can be effected by a person single-handed.

An object of the present invention is to provide as a new article of manufacture a novel or improved needle or needle attachment for hand knitting so constructed as to obviate the foregoing disadvantages while enabling the work to be facilitated and accelerated.

Another object of the invention is to provide a hand knitting needle as aforesaid incorporating a measuring scale enabling the person who is knitting to effect proper measurements and size comparisons on the fabric being knitted without resorting to an extraneous tape measure or like instrument or gage.

Yet another object of the invention is to provide a hand knitting needle as aforesaid wherein the measuring scale is engraved, affixed or otherwise provided on a core stem so removably held, for example by friction, through the transparent shank or body of the needle as to be readily disengageable therefrom, thereby enabling quick and easy measurements to be taken on the fabric being knitted while it is still carried on the needle shank or otherwise.

A further object of the invention is to provide a hand knitting needle as aforesaid embodying colored means so associated with the indices constituting the measuring scale as to enhance their legibility by awarding them greater striking effect for the user's eyes.

A still further object of the invention is to provide a hand knitting needle as aforesaid having parts such for example as the pointed tip end and at least some of the indices forming the measuring scale made of a phosphorescent or luminescent substance so as to be visible in an attenuated light or in darkness and to render knitting feasible under such light conditions.

With these and such other objects in view as will incidentally appear hereafter, the invention comprises the novel construction and combination of parts that will now be described hereafter with reference to the accompanying diagrammatic drawing exemplifying four different embodiments of the same and forming a part of the present disclosure.

In the drawing:—

Figure 1 is a fragmentary elevational view of a hand knitting needle constituting a first embodiment of the invention, assuming the measuring scale to be on the needle shank.

Figure 2 is a fragmentary view similar to fig. 1 showing a second embodiment of the knitting needle, assuming the measuring scale to be provided on a core stem engaged through a hollow shank and visible through the latter owing to its transparency.

Figure 3 is a fragmentary view similar to fig. 1 showing a third embodiment of the knitting needle, assuming colored spots or patches on the shank to be associated with the measuring scale.

Figure 4 is a fragmentary elevational view of a hand knitting needle constituting a fourth embodiment of the invention, assuming the core stem bearing a measuring scale to be partly disengaged from the hollow shank.

Like reference characters designate like parts throughout the several views.

Reference being first had to fig. 1, the needle comprises a shank *a* made of any suitable flexible or so-called plastic and preferably transparent material such as horn, celluloid, synthetic resin or the like. The shank *a* has a pointed tip end *b* and is hollow to accommodate a core stem *c* fitted at one extremity with a projecting head *d* of bulbous shape abutted and held on the edge of the open end of said shank *a*. Intermediate the tip end *b* and the head *d* the shank *a* is provided at regular intervals with index lines *e* referenced by consecutive numerals *f* so as to form a measuring scale.

The distance between each index line *e* and the following one is divided by sub-index lines such as *g* and may be equal to any common linear unit such as a centimeter or an inch. No limitation is, however, involved in this since, as will be understood, any fine and/or coarse graduation may be provided on the needle for coping with the particular kind or fineness of the knitting work to be carried out. Advantageously the nu-

Published June 1, 1943

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ALIEN PROPERTY CUSTODIAN

METHOD AND DEVICE FOR FILTERING AND PURIFYING THE GASES OF GAS PRODUCERS

Arnold Schroter, Villefranche-sur-Saone (Rhone), France; vested in the Alien Property Custodian

Application filed September 22, 1942

In most gas producing plants, it is desired to condense the steam contained in the gases before the latter reach the purifying device. It is, in fact, essential to prevent any clogging of the filter through the dust and like particles adhering against the walls of purifying or filtering material.

However, the temperature and hygrometric grade of the atmospheric air being extremely variable, the coolers provided are consequently not always sufficient for wholly condensing this steam, which leads to a defective operation of the purifying device.

Now the present invention, in contradistinction with the existing processes, relates to a novel purifying method according to which the gases are acted upon either in the gas generator itself or immediately at the exit thereof so as to be still at a temperature sufficiently above the condensation temperature of the vapours contained in the gases such as steam, tar vapour and the like, for these vapours to pass in the state of dry vapour through the filtering refractory porous material located in proximity to the exit of the gases from the generator.

The gases are thus purified while still hot and dry, so that the dust particles cannot adhere to the filtering partition through which the steam and vapours pass in the dry state.

The filtering partition or partitions considered are arranged in the path of the hot gases passing out of the generator before same have undergone any cooling and said partitions may be executed in any desired or approved manner.

Appended drawings show diagrammatically by way of example some of the arrangements which may be used with advantage in the execution of the invention.

Figs. 1, 3 and 5 are partly sectional elevational views of different forms of gas producers according to my invention, Figs. 3 and 5 being shown with their upper portion partly broken off.

Figs. 2, 4 and 6 are horizontal cross-sections respectively along lines 2—2, 4—4 and 6—6 of Figs. 1, 3 and 5 respectively.

In the form of execution illustrated in Figs. 1 and 2, the purifying device is constituted by a cylinder *a* coaxial with the gas producer and yieldingly held between the packings *b* in a manner such that it surrounds the lower part *c* of the furnace, which part may have a substantially double frustoconical shape as shown or any other suitable shape.

In the modification according to Figs. 3 and 4, the purifying device is constituted by an arrangement of refractory plugs *d* annularly distributed on an inner partition *e* disposed in the annular passage provided for the gases.

Lastly according to Figs. 5 and 6, the purifying device comprises two vertical filtering plates *f* which I prefer to arrange slidingly in the grooves *g*.

In all forms of execution, the hot gases passing out of the furnace *c* through the opening *h* in the latter are thus compelled to pass through the filtering member or members *a*, *d* or *f* before they are submitted to any cooling; the filtering is thus performed on perfectly dry gases, the water and cloggy material such as tar, carried along by the gases, being still in the state of dry steam or vapour.

As obvious and as apparent from the above, my invention is by no means limited to the sole forms of execution described hereinabove; on the contrary it includes all modifications which may appear to those skilled in the art; in particular the purifying device may if desired be arranged just outside the gas generator at a point where the gases have not yet been submitted to any cooling sufficient to bring their temperature underneath the above defined value.

ARNOLD SCHROTER.

PUBLISHED

JUNE 1, 1943.

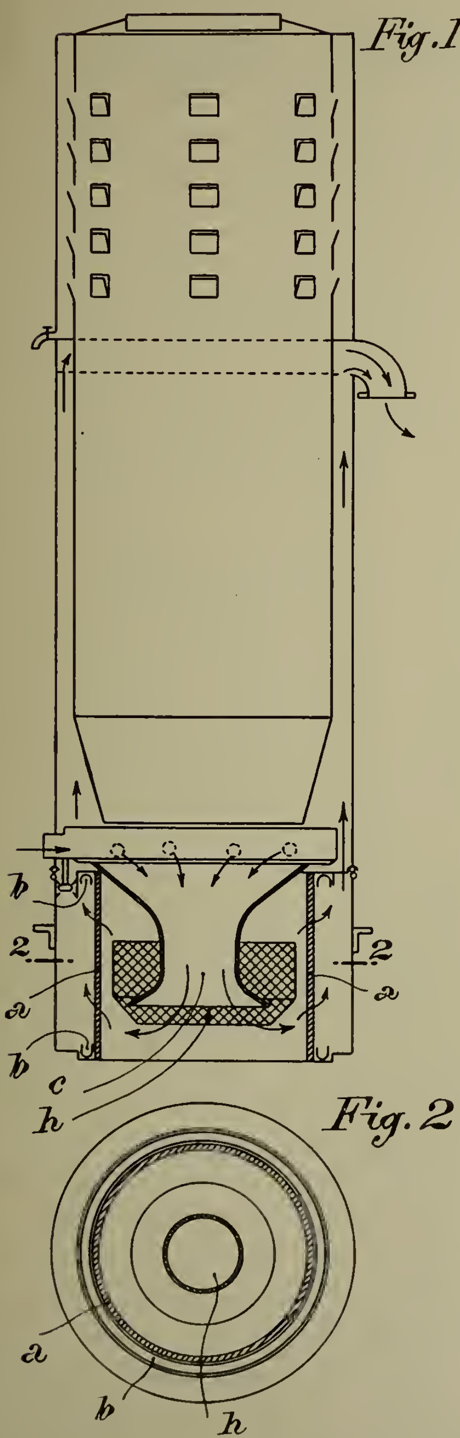
BY A. P. C.

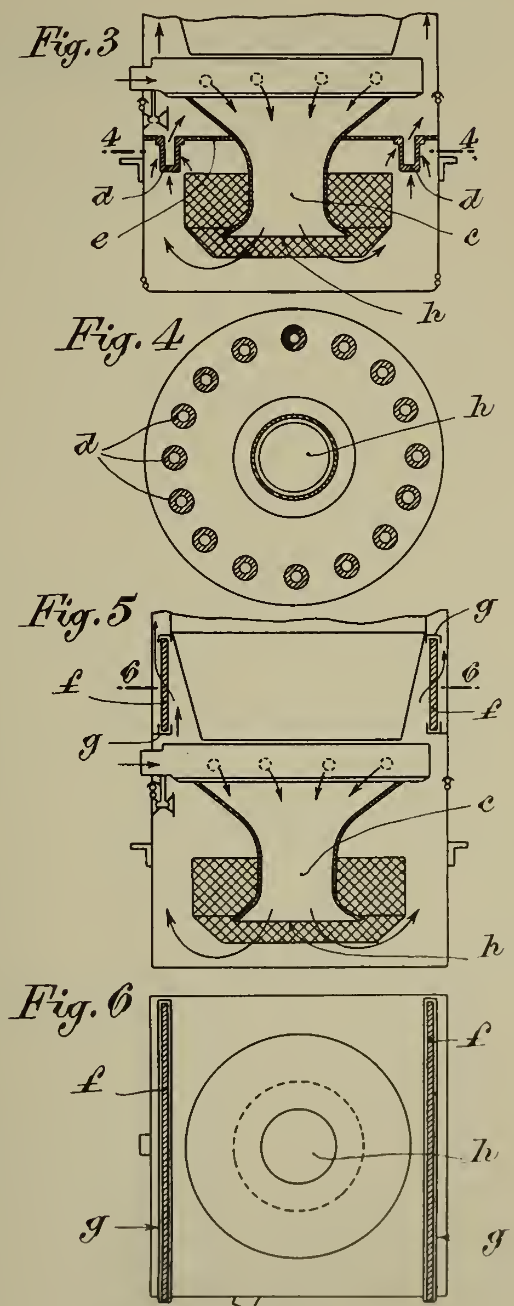
A. SCHROTER

METHOD AND DEVICE FOR FILTERING AND PURIFYING THE GASES OF GAS PRODUCERS

Filed Sept. 22, 1942

Serial No. 459,344





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ALIEN PROPERTY CUSTODIAN

ELECTRIC MOTORS THE SPEED OF WHICH IS REGULARIZED BY A TUNING-FORK

Raymond Joseph Jasse, Vichy, France; vested in the Alien Property Custodian

Application filed October 15, 1942

The present invention relates to electric motors the speed of which is rendered constant by being placed under the control of a standard tuning-fork.

It is adapted to constitute a unit which ensures to the motor not only an average rigorously adjusted speed, but an instantaneous speed completely regular and independent, in particular, of the voltage of the source of supply for the control, for instance, of measuring or recording apparatus.

Units are known which are constituted by a standard tuning-fork **1** (Fig. 1) and an electric motor shunt **2** the spindle of which carries a half-ring **3** establishing the contact on a half of each revolution with the brush **4**. The regulation takes place by the action of said intermittent contact **3—4** and of a second intermittent contact **5—1** established by the tuning-fork. The two intermittent contacts **3—4** and **5—1** are mounted in parallel on the resistance **6** mounted in series on the inducing winding **7** and which is short-circuited when one or the other of the intermittent contacts **3—4** or **5—1** is established.

In Fig. 2 has been shown the action of the two intermittent contacts **3—4** and **5—1**. Line A shows in time the operation of the intermittent contact **5—1** controlled by the tuning-fork; line B the operation of the intermittent contact **3—4** controlled by the motor; line C the short-circuits on the resistance **6** which result therefrom. The contact is established by the tuning-fork a_0 to a_1, then from a'_0 to a'_1 from a''_0 to a''_1, etc. It is established by the motor from b_0 to b_1, from b'_0 to b'_1, etc. The resistance **6** will therefore be short-circuited, consequently, the current in the inducing winding **7** will be increased and the speed of the motor reduced from b_0 to a_1, from b'_0 to a'_1, etc. The average speed of the motor will tend to be so much the more reduced as the short-circuit of the resistance **6** will be prolonged. In order that the motor should effect exactly one revolution when the tuning-fork effects a complete oscillation, it is necessary that the offsetting in the time of the establishment of both intermittent contacts should determine an average induction exactly corresponding to the speed thus defined.

If it is admitted that this condition is approximately satisfied, and if it is assumed that the speed of the motor has a tendency to increase, the breaking faces a_1, a'_1, etc. of contact **5—1** depending on the tuning-fork will remain the same. The establishing faces b_0, b'_0, etc. of contact **3—4** depending on the motor will tend to advance. The durations of the short-circuit b_0 a_1, b'_0 a'_1, etc. will therefore have a tendency to increase. Consequently, the speed will tend to diminish until the average duration of the short-circuit is brought to a value which imparts to the motor the speed of synchronism. Conversely, any diminution of speed will have for effect to reduce the average duration of the short-circuit and, consequently, to bring back the speed to the value of synchronism. The unit therefore constitutes a synchronous regulator the average speed of which is determined by a tuning-fork the frequency of which is independent of the movements of the adjusted member and can be obtained with all the required accuracy.

The units which can be obtained with this diagram by utilising sustained tuning-forks having ordinary contacts present two inconveniences; if the average speed is exact this result is only obtained at the price of incessant variations of the instantaneous speed; furthermore, it is noticed that if the speed of the motor is, for any reason, considerable variations of potential for instance, appreciably different from synchronism, the latter can no longer be automatically re-established.

The invention has for object an improved unit constituted by a sustained vibrator of constant frequency, adapted to simultaneously obtain a displacement of the contact perfectly defined to the required frequency without super-position of harmonics, and a very high output of the sustaining magnetic circuit, and by a controlled electric motor provided with a speed limiting device intended to prevent the motor from racing and bringing back its speed to a value approximating synchronism.

Such a device allows of reducing the sustaining current to a very small value, without breaking spark, which ensures the cleanness of the contacts. It also ensures the perfect regularity of the instants of establishment and of breaking of the control contact, so that not only the average speed, but the instantaneous speed of the controlled motor remains constant. Finally, the regulator of the motor ensures a preliminary establishment of synchronism in such a manner that, in the event of falling out of tune, due for instance to an important variation of the supply voltage, the motor assumes by itself a speed sufficiently near synchronism to allow the control to act.

It essentially consists in a sustained vibrator of constant frequency composed of two rigid beams carrying dead-heads connected to the

frame of the apparatus by springs of suitable rigidity and pivoting about their middle points, one of said beams carrying an armature and a contact identical to those of telegraphic relays; said armature is subjected to the action of a magnetic circuit provided with an inducing winding identical to those of telegraphic relays; said contact can supply, on the one hand, the inducing winding for sustaining the movement of said vibrator, on the other hand, a telegraphic relay displacing a contact allowing, as is known, the control of an electric motor shunt, which carries a centrifugal regulator establishing a contact in parallel with the contacts controlling said motor when the speed of said motor exceeds the speed of synchronism.

The invention will, in any case, be clearly understood by means of the following description and accompanying drawing, which is a diagram given, above all, by way of indication.

In said drawing:

Fig. 3 shows the electric diagram of the unit;

Fig. 4 shows the mounting of the two beams constituting the vibrator;

Fig. 5 shows the mounting of the armature, of the contact and of the magnetic circuit sustaining the vibration.

In Fig. 3, the vibrator 8 carries the sustaining contact 9, which is capable, during the displacement of the beam 10, of touching the fixed contact 11.

The contact thus established gives to the current of the cell 12, access:

1. To the resistance 13, then to the magnetic winding 14 on which is mounted in parallel the condenser 15. The resistance 13 and condenser 15 are so calculated that between the current passing through the winding 14 and the movement of the contact 9 combined with the beam 10, a phase displacement is established which is approximately equal to a quarter of a period ensuring the sustaining of the vibration of the beam for the least consumption of electric energy.

2. To the resistance 16, then to the winding 17 of the telegraphic relay 18, the armature of which thus moves by reproducing the establishments and breakings of the contact 9—11. A condenser 19 mounted in parallel on the winding 17 avoids the production of breaking sparks at the contact 9—11 which would rapidly soil it.

The armature 20 of relay 18 is capable of coming in contact with the fixed contact 21, establishing an intermittent contact which plays the part of contact 5—1 of Fig. 1. The use of this relay can be avoided by causing a contact directly established, to be directly controlled by the beam. But there is a danger of determining on a contact forming a part of the vibrator, wear due to the breaking sparks which can put the vibrator out of working order and modify its adjusting period. It is much preferable to use the intermediary of a relay which can be replaced or adjusted when its contacts are worn without inconvenience for the adjustment of the vibrator.

The motor 22 carries on the one hand, the half-ring 23 establishing the contact at every half-revolution with the brush 24, on the other hand, a centrifugal regulator establishing the contact 25 when the speed of the motor exceeds from 1 to 2 per cent the speed of synchronism.

The three contacts 20—21, 23—24 and 25 are mounted in parallel on the resistance 26 mounted in series on the inducing winding 27 of the motor.

If the vibrator is assumed to be in action and sustained by the action of the contact 9—11 and of the winding 14, the relay 18, under the action of the current established by the contact 9—11, vibrates at the period of the vibrator 8. Synchronism is established as above stated by the action of contact 20—21 playing the part of contact 5—1, Fig. 1, and of contact 23—24 playing the part of contact 3—4, Fig. 1. If the motor has a tendency to race, its speed is maintained by the action of contact 25 at a value sufficiently near synchronism for the latter to be established.

Figs. 4 and 5 clearly define the principle of the sustained vibrator. The frame 28 (Fig. 4) carries, through the medium of a common suspension spring 29, the two balanced beams 30 and 31 respectively carrying the dead-heads 32 and 33. A common spring 34 is attached to both beams symmetrically at the points 35 and 36 and to the frame at the point 37.

The beam 30 carries (Fig. 5) a telegraphic relay armature 38. On said armature is secured by means of a flexible blade 39 a movable contact 40 capable of touching a fixed contact 41 accurately adjustable in position by means of the micrometer screw 42.

When the contact 40—41 is established, the current from the cell 12 is sent, through the medium of resistance 13, in the inducing winding 14 Fig. 3 (43 Fig. 5). The differential magnetic circuit 44, polarized by the permanent magnet 45, attracts the armature 38 so as to cause the beam 30 to rock in clockwise direction. The attraction ceases when the contact 40—41 is broken. Owing to the system constituted by the resistance 13, the self of the relay and the condenser 15, the establishment of the attraction and its interruption possess a definite lag on the establishment and the breaking of the sustaining contact 40—41. The phase displacement necessary for ensuring sustaining is thus obtained. The inducing winding 14 having a very reduced self no spark is produced at the contacts. The relay equipment having a high electro-mechanical output, a very small intensity is sufficient for sustaining the oscillations. The contacts 40 and 41 therefore work in excellent conditions and, in practice, last indefinitely.

The system reduced to the beam 30 equipped with the dead-heads 32 and spring 34 sustained by the relay Fig. 5 would suffice for constituting a vibrator of definite frequency. However, it has a very serious inconvenience: it begins to oscillate only if the frame of the relay is very heavy and its period depends on the bulk of said frame. It is even modified if the frame is moved from one table to another.

It is in order to remedy this inconvenience that the frame carries a second beam 31 equipped with two deadheads 33 and a spring 34. This unit is tuned so as to give the same period of vibration as the unit of the beam 30. When the latter begins to vibrate, it drives, by the action of the flexibilities of the connection members, the synchronous beam 31 which begins to oscillate in the reverse direction, balancing for the greater part the oscillation of beam 30. The common oscillation reaches a great amplitude and the period is rendered independent of the suspension of the frame.

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R. J. JASSE
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Serial No.
462,134

2 Sheets-Sheet 1

Fig. 1.

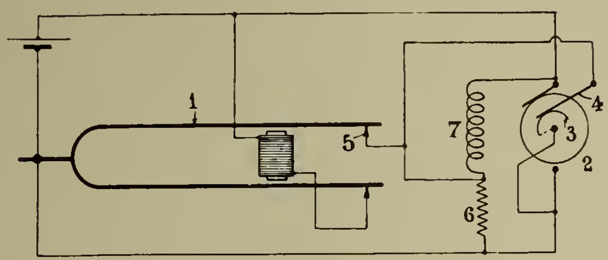

Fig. 2.

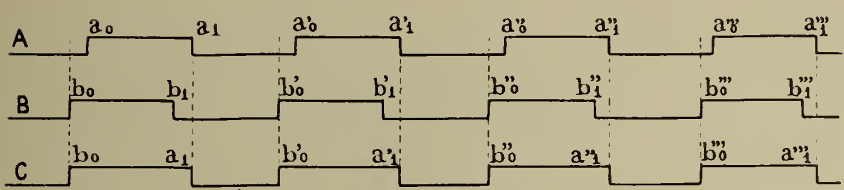

Fig. 3.

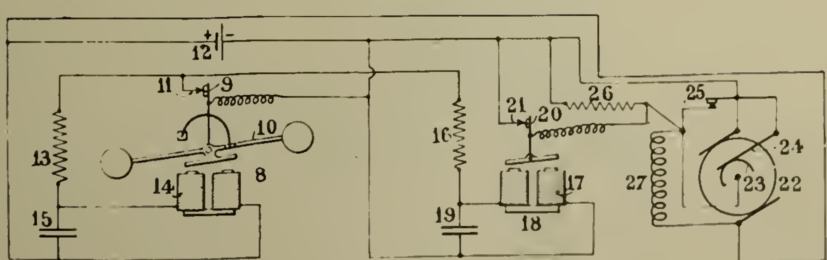

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Fig. 4.

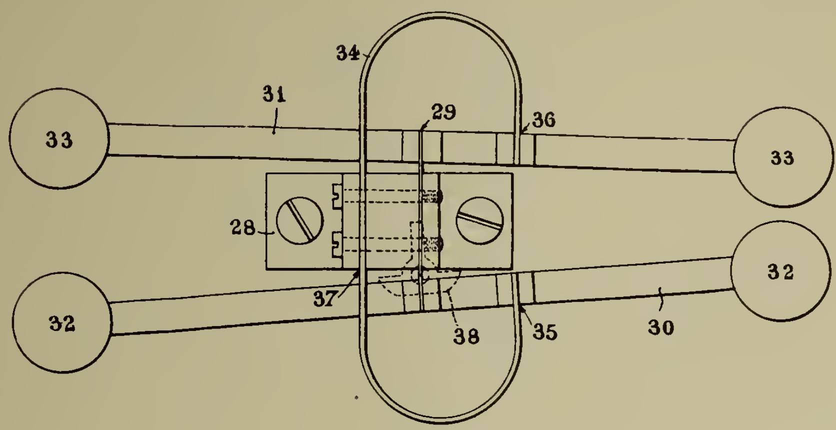
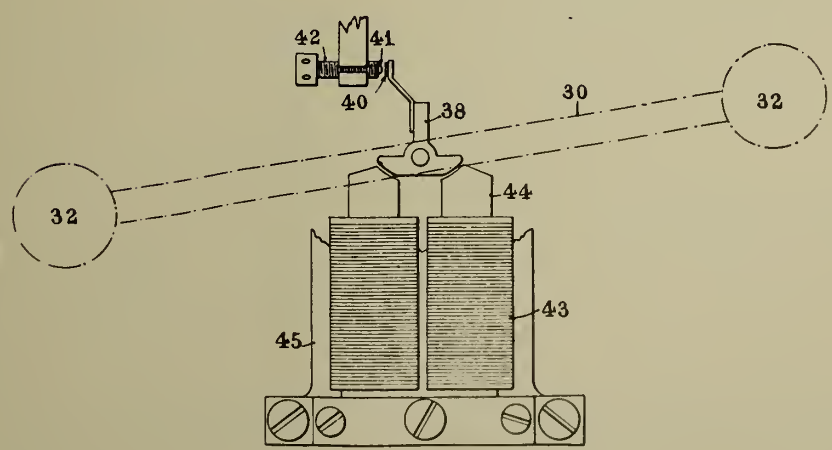


Fig. 5.



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ALIEN PROPERTY CUSTODIAN

HYDRAULIC PRESSES

Marius Adrien Monier, Grillon, by Valreas, France; vested in the Alien Property Custodian

Application filed October 28, 1942

Generally the correct operation of a press supposes that the resultant of the passive forces (resistance of the compressed article), the value of which is equal to that of the active forces (compression stresses), is directly opposed to this latter.

If, for any reason (abnormal distribution of the resistances or casual disappearing of certain ones of the same), this condition is no longer fulfilled, that is to say if a shifting occurs between the respective axes of application of both resultants in question, this shifting immediately gives rise to a reversing torque which in the case of presses of large dimensions can have serious consequences.

Without going so far as to cause in every case permanent deformations of the apparatus the above mentioned torque nevertheless imposes to the various organs of the press deflecting stresses which have as a visible consequence a lack of parallelism of the beds.

Without necessarily being dangerous these flexions give rise, in any case, to complementary frictions and even, on occasion, to jamming effects which are contrary to a satisfactory workings of the press.

In ordinary presses one generally relies on the operator of the press for stopping the work as soon as the above mentioned lack of parallelism of the beds appears.

For presses of a great power, on the contrary, and especially for the press which forms the subject matter of the chief patent, it has seemed necessary to provide a complementary safety device capable of automatically re-establishing the situation as soon as an abnormal shifting of the applied forces appears.

The safety device in question is characterized by the combination with the usual member controlling the admission and the outlet of the fluid under pressure which feeds the cylinders of the press (distributor) of an auxiliary control mechanism which, if necessary or advisable, automatically puts out of action one or more cylinders or cylinder groups, the said auxiliary mechanism comprising:

(1°) According to the case, i. e. according to the number of the press cylinders and according to the manner in which it is desired to group the said cylinders, one or more auxiliary distributors adapted for permitting separately to regulate the supply of fluid to the various cylinders or cylinder groups under consideration;

(2°) When two auxiliary distributors are provided, a box with complementary valves adapted for co-ordinating the action of the said auxiliary distributors;

(3°) Lastly, and still according to the arrangement of the press cylinders, one or two compensating controls having a differential action, combined with the above mentioned auxiliary distributor or distributors and connected with the movable bed of the press in such a manner that at the moment where the lock of parallelism of the two beds reaches a given value the said control or controls act on the auxiliary distributor or distributors with which they are combined so as to stop the admission of the driving fluid for one or more cylinders or cylinder groups.

If the press comprises only one row of cylinders it is, of course, sufficient to have a single auxiliary distributor which is suitably arranged and a single compensating control, since one has to care only for the longitudinal parallelism of the beds.

On the contrary, when the press comprises two rows of cylinders two auxiliary distributors are necessary with one complementary valve box and two compensating controls having a differential action, one of the said controls being assigned to the control of the longitudinal parallelism of the beds and the other to the control of their transversal parallelism.

A particular form of execution of a device suited for carrying out the invention is shown in the appended drawings and described by way of example, but, of course, the said form of execution could be modified in its details of construction without departing from the scope of the invention.

Figure 1 is a general diagrammatical plan view of the device.

Figure 2 is an elevational view of the outside of the device in the longitudinal direction with a partial tearing away showing the inner part of a cylinder and a partial sectional view through line II—II of Figure 1.

Figure 3 is also an elevational view of the outside in the lateral direction with a partial sectional view through the line III—III of Figure 1.

As shown in the drawing, the press which is described and shown by way of example comprises eight compression cylinders C_1, C_2, C_3, C_4, C_5, C_6, C^7, C_8 associated with fixed bed S_1 and with the movable bed S_2 according to what is said in the chief patent, the said cylinders being, as shown hereinafter and as regards their supply with driving fluid, distributed in four groups G_1, G_2, G_3, G_4, the group G_1 comprising the cylinders C_1 and C_2, the group G_2 the cylinders C_3 and C_4, the

group G_3 the cylinders C_6 and C_6 and the group G_4 the cylinders C_7 and C_8.

The control of the press is insured by means of a general distributor D and of two auxiliary distributors d_1 and d_2 which are respectively subjected to the action of the compensating control mechanism m_1 and m_2 the first of which corresponds to the longitudinal balance and the second to the lateral balance, the said auxiliary distributors being adapted for controlling the operation of a valve box B which regulates the supply of the driving fluid to the various cylinder groups.

The general distributor D, which could also be of another type as that which is shown in the drawing, is formed here of a three way cock comprising a block **1** to which leads the conduit **2** supplying the cylinders with fluid under pressure and from which extend on the one hand the conduit of distribution **3** and, on the other hand, the outlet conduit **4**.

Two valve needles **5** and **6** respectively movable in the cavities **7** and **8** provided in the said block **1** insure, in function of the movements imparted to them by a control lever **9** to which they are linked at **10** and **11** respectively, either the connection of the inlet conduit **2** for the fluid with the distributing conduit **3** or the interruption of the said communication and the connection of the said distributing conduit **3** with the outlet conduit **4**.

The valve box B which is supplied with driving fluid by the conduit **3** when the valve needle **5** of the general distributor is open is formed of a block **12** in which are arranged six differential valve casings **13**, **14**, **15**, **16**, **17** and **18** respectively in which the movable differential valves **19**, **20**, **21**, **22**, **23** and **24** can be moved.

From the lower seat of the valve **21** extends the conduit **25** with two branches **25a** and **25b** through which both cylinders C_1 and C_2 of the group G_1 are supplied with fluid respectively.

From the lower seat of the valve **22** extends the conduit **26** which has two branches and supplies both cylinders C_3 and C_4 of the group G_2 with fluid.

From the lower seat of the valve **23** extends the conduit **27** which has also two branches and supplies with fluid both cylinders C_5 and C_6 of the group G_3.

From the lower seat of the valve **24** extends the conduit **28** with two branches supplying with fluid both cylinders C_7 and C_8 of the group G_4.

Owing to this arrangement the advantage of which will be shown hereinafter the various cylinder groups are supplied with fluid independently from another.

Furthermore, the casings of the valves **21** and **22**, which insure the control of the feeding of all the cylinders of the same row are supplied with driving fluid only then when the valve **19** is open, and the casings of the valves **23** and **24**, which insure the control of the cylinders of the other row, are supplied with driving fluid only then when the valve **20** itself is open, owing to which the play of both valves **19** and **20** permits of neutralizing each one of both cylinder rows independently from another according to the needs.

The control of the opening and closing of the six differential valves of the valve box B is itself insured through the medium of both auxiliary distributors d_1 and d_2 which are identical, but the first of which is subjected to the action of the longitudinal compensating mechanism m_1, as for instance by means of a driving rod **29** of the like, whilst the second is subjected to the action of the transversal compensating mechanism m_2, which acts by means of the rod **30**.

The distributor d_1, which has the duty of insuring the longitudinal control by putting out of action either both groups G_1 and G_4 or both groups G_2 and G_3 according to the case is formed itself of a block **31** to which leads a conduit **32** supplying the fluid under pressure and connected with the conduit **3** of the general distributor D and from which extend:

(1°) a conduit **33** which leads to the upper part of the casings of the differential valves **22** and **23** in view of controlling the feeding of both cylinder groups G_2 and G_3;

(2°) a conduit **34**, which leads to the upper part of the casings of the differential valves **21** and **24** in view of controlling the feeding of both cylinder groups G_1 and G_4, and

(3°) lastly a discharge conduit **35** which joins the outlet conduit **4** of the general distributor D.

In the said block **31** are arranged four valve needle casings **36**, **37**, **38** and **39** respectively, adapted for receiving four valve needles **40**, **41**, **42** and **43** the two first ones of which are mounted and linked on a control link **44** itself linked at **45** on the master rod **29**, whilst the two others are linked on a control link **46** itself linked at **47** on the master rod **29**.

Moreover, the valve needle **40** and the link **44** are subjected to the action of a compression spring **48** which rests on a fixed point **49** and constantly tends to maintain the valve needle applied against its seat in order to prevent the driving fluid arriving through the conduit **32** to flow into the casing of the valve needle **41** and in a like manner the valve needle **42** and the link **46** are subjected to the action of a compression spring **50** which rests against a fixed stop **51** and constantly tends to apply the said valve needle onto its seat in order to prevent the driving fluid arriving through the conduit **32** to flow into the casing of the valve needle **43**.

The casing of the valve needle **41** permanently communicates with the conduit **34** and the casing of the valve needle **43** permanently communicates with the conduit **33**, but since these two casings also communicate with the discharge conduit **35** so long as their respective valve needles remain in the opened position, the fluid under pressure can exert its action on the valves **21**, **22**, **23** and **24** of the valve box only if the rod **29** is moved sufficiently for first closing one or the other of the said valve needles **41** or **43** and for opening then either the valve needle **40** or the valve needle **42** while overcoming the force of the corresponding compression spring.

In a like manner, the auxiliary distributor d_2 which has for its duty to insure the lateral control by putting out of action either one or the other of both cylinder rows, according to the case, comprises a block **52** to which leads a conduit **53** for the supply with the driving fluid coming from the conduit **3** of the general distributor D and from which extend:

(1°) a conduit **54** which leads to the upper part of the casing of the valve **19** in order to control the feeding of both cylinder groups G_1 and G_2 of one and the same row;

(2°) a conduit **55** which leads to the upper part of the casing of the valve **20** in order to control the feeding of both cylinder groups G_3 and G_4 of the other row, and

(3°) lastly, a discharge conduit **56**, which joins the outlet conduit **4** of the general distributor D.

In the said bloc **52** are arranged four valve

needle casings 57, 58, 59 and 60 which receive four valve needles 61, 62, 63 and 64 linked: the two first ones on a link 65 itself linked at 66 on the master rod 30 and the others two on a link 67 itself linked at 68 on the rod 30, the valve needle 61 and the link 65 being acted upon by a spring 69 which rests against a fixed stop 70, while the valve needle 63 and the link 67 are acted upon by a spring 71 resting against a fixed stop 72.

The casing of the valve needle 62 permanently communicates with the conduit 54 and the casing of the valve needle 64 permanently communicates with a conduit 55, but since each of these two casings also communicates with the discharge conduit 56 as long as its valve needle remains in the opened position, the fluid under pressure can exert its action on both valves 19 and 20 of the valve box only when the rod 30 is moved sufficiently for causing first the closure of one or the other of the said valve needles 62 or 64 and then the opening either of the valve needle 61 or of the valve needle 63 while overcoming the force of the corresponding compression spring.

On its side, the auxiliary mechanism adapted for insuring the longitudinal compensation comprises two vertical racks 73 and 74 integral with the bed S_2 and movable with it, the said racks engaging respectively, the first a pinion 75 capable of freely rotating about a fixed axis 76 integral with the bed S_1 and the second a pinion 77 also capable of freely rotating about a fixed axis 78 integral with the bed S_1.

It comprises, furthermore, two horizontal double racks 79 and 80 which can slide in guides 81 and 82 respectively on the fixed bed S_1.

The teeth 79_a of the rack 79 engage the pinion 75 and the teeth 80_a of the rack 80 engage the pinion 77. On the other hand, between the teeth 79_b of the rack 79 and the teeth 80_b of the rack 80 is arranged a pinion 83 which can freely rotate about an axis 84 mounted at one end of a yoke 85 the other end of which is linked at 86 on one of arms of a bell-crank lever 87 which can rock about an axis 88 integral with the bed S_1.

At the end of the other arm of the bell-crank lever is connected the upper end of the above mentioned rod 29.

In a like manner, the auxiliary mechanism adapted for insuring the lateral compensation carries first two vertical racks 89 and 90 integral with the bed S_2 and moving with it, the said racks engaging respectively, the first one a pinion 91 capable of freely rotating about a fixed axis 92 integral with the fixed bed S_1 and the second a pinion 93 also capable of freely rotating about a fixed axis 94 integral with the bed S_1.

On the other hand, it comprises two double horizontal racks 95 and 96 which can slide in guides 97 and 98 respectively on the fixed bed S_1.

The teeth 95_a of the rack 95 engage the pinion 91 and the teeth 96_a of the rack 96 engage the pinion 93.

On the other hand, between the teeth 95_b of the rack 95 and the teeth 96_b of the rack 96 is arranged a pinion 99 which can freely rotate about an axis 100 mounted at one of the ends of a yoke 101 the other end of which is linked at 102 on one of the arms of a bell-crank lever 103 which can rock about an axis 104 integral with the bed S_1.

At the end of the other arm of the said bell-crank lever is connected the end of the above mentioned rod 30.

The operation of the device is as follows:

When all the parts are in the position in which they are shown in the appended drawing, the driving fluid arriving through the conduit 2 can pass under the valve needle 5 and from here through the conduit 3 into the valve box B.

In the inner of the latter it can also pass under the valves 19 and 20 and then into the space under the valves 21, 22, 23 and 24 and finally reach the eight cylinders of the press through the conduits 25, 26, 27 and 28.

Under its action the movable bed S_2 is lowered and comes nearer to the fixed bed S_1.

So long there is no abnormal shifting between the axes of application of the resultant of the active forces and that of the passive resistances the four racks 73, 74, 89 and 90 which follow the bed S_2 in its downward movement are moved exactly by the same amount. The same is true for the horizontal racks 79, 80, 95 and 96 and, consequently, both pinions 83 and 99 rotate each about its own axis without the latter being compelled to move. The bell-crank levers 87 and 103 remain unmoved as well as the rods 29 and 30. The valve needles 40 and 42 of the auxiliary distributor d_1 and the valve needles 61 and 63 of the auxiliary distributor d_2 remain closed. The conduits 32 and 33 which lead to the said auxiliary distributors supply no driving fluid.

If, for any reason, an abnormal shifting occurs between the axes of application of the active forces and of the passive resistances acting between the beds, and if this shifting is sufficient for preventing the movable bed S_2 to move further parallely to itself and parallely to the fixed bed S_1 a certain difference appears between the respective displacements of the various racks 73, 74, 89 and 90.

In order to simplify the explanation it will be supposed first that the shifting in question is such that the movable bed S_2 of the press undergoes a certain tilting movement in the longitudinal direction as, for instance, from the right to the left, with respect to an observer looking at Figure 2, without undergoing any tilting movement in the lateral direction.

In this case, the rack 73 moves downward faster than the rack 74 and the rack 79 moves from the right to the left by an amount which is larger than that by which the rack 80 moves itself from the left to the right.

Accordingly, the axis 84 of the pinion 83 is compelled to move from the right to the left for compensating this difference, while carrying with it the yoke 85, which obliges the bell-crank lever 87 to rock about its axis, thus causing a downward movement of the rod 29.

This downward movement leaves the valve needle 42 of the auxiliary distributor d_1 in the closed position, but it causes first the closure of the valve needle 41 and then, when it has reached a sufficient value, the opening of the valve needle 40.

At this moment the driving fluid which arrives through the conduit 32 can pass under the valve needle 40 and round about the valve needle 41 and then through the conduit 34 above the valves 21 and 24.

Since the section of the upper end of both these valves is larger than that of their lower end the action of the fluid which acts on their upper face is greater than that of the fluid which acts on their lower face. Consequently, the said valves are moved against their seat and they cut off the communication between the conduit 3 supplying the driving fluid and the conduits 25 and 28 which feed both cylinder groups of the left hand G_1 and G_4, that is to say the cylinders C_1, C_2, C_7, C_8.

Since the latter are no longer supplied with driving fluid the axis of application of the resultant of the active pressures immediately tends to move from the left to the right in order to re-establish the desired balance.

As this movement proceeds the pinion **83** tends to return to its middle position, as well as the bell-crank lever **87** and the rod **29**.

The valve needle **40** rises to its closing position again and then the valve needle **41** opens, thus putting the conduit **34** and, accordingly, the space above the valves **21** and **24** in communication with the discharge conduit **35**. The valves **21** and **24** can open again in order to supply fluid to the cylinders C_1, C_2, C_7 and C_8.

A tilting movement of the movable bed S_2 in the other direction would cause the rod **29** to raise and the valves **22** and **23** to close.

If it is the lateral balance which is disturbed, without the longitudinal balance being affected, it is the axis **100** of the pinion **99** which moves and causes, according to the case, an upward or a downward movement of the rod **30**. According to the direction of the movement of the latter, an operation similar to that which has just been described causes the closure of one or the other of the two valves **19** and **20** of the valve box B. If it is the valve **19** which closes, the flow of the fluid towards the cylinders C_1, C_2, C_3 and C_4 of one of the cylinder rows is cut off. On the contrary, if it is the valve **20** which closes, it is the supply of fluid to the cylinders of the other cylinder row which is cut off.

Of course, two tilting movements, i. e. a longitudinal and a lateral movement can be combined and cause then the stopping of three cylinder groups.

When the operator of the press desires to stop his machine, he needs only to move the lever **9** from the right to the left. Thus he causes the closure of the valve needle **5** and the opening of the valve needle **6**. Consequently, he cuts off the supply of driving fluid and permits to the fluid in the cylinders to flow back through the valve box B and the conduit **3** and to escape through the conduit **4** at the moment when the usual control device **105** for the raising of the movable bed begins to work.

Although the form of execution which has been described and shown by way of example corresponds to a press with eight compression cylinders of the type of the press with ten cylinders which has been described in the chief patent, it is obvious that a man skilled in the art would be able, without any difficulty, to make in the same conditions a device applicable either to a press with another number of cylinders or to a press using cylinders of another type for the control of the beds, or finally to a press in which all cylinders would not be adapted for taking part in the compensating action of the mechanism in question.

It is also obvious that the above described compensating rack mechanisms and auxiliary distributors could be replaced by any other equivalent system without departing from the scope and spirit of the invention.

MARIUS ADRIEN MONIER.

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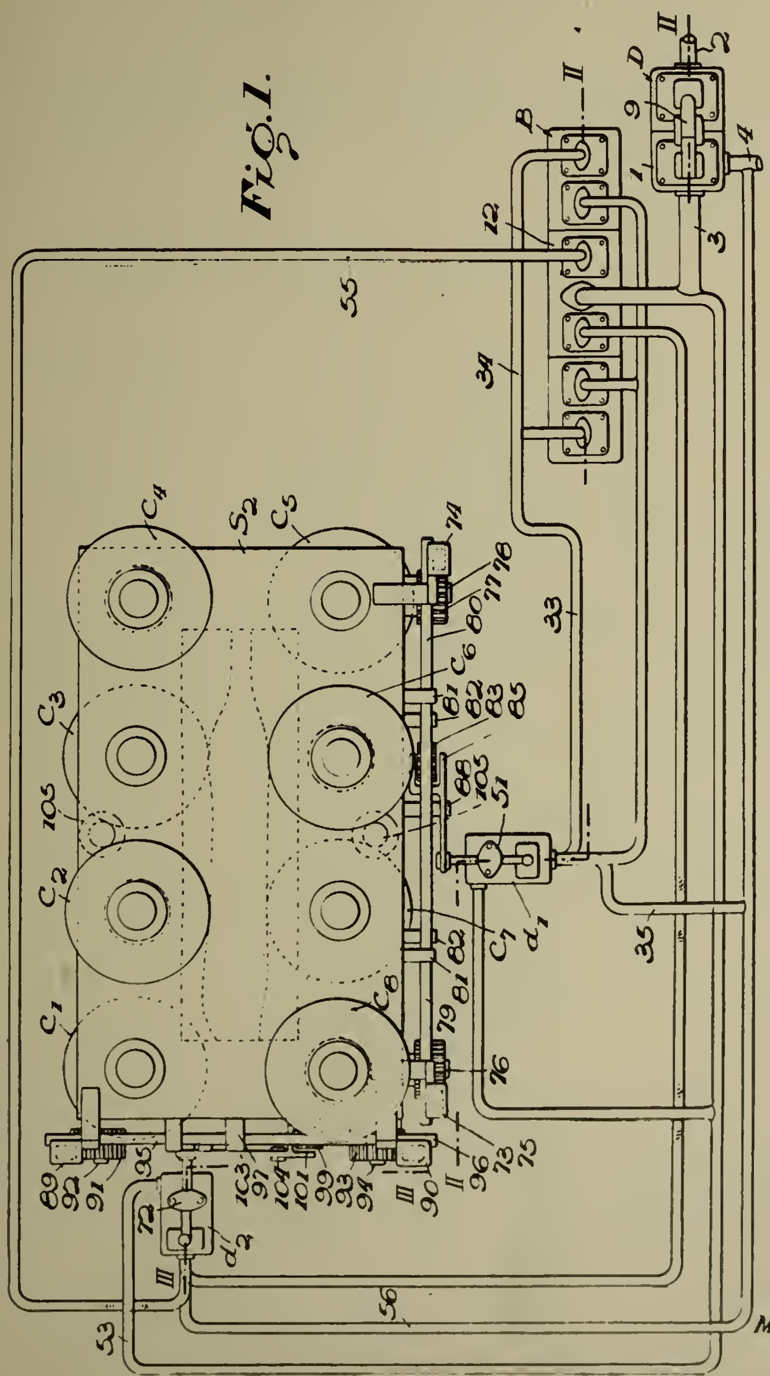

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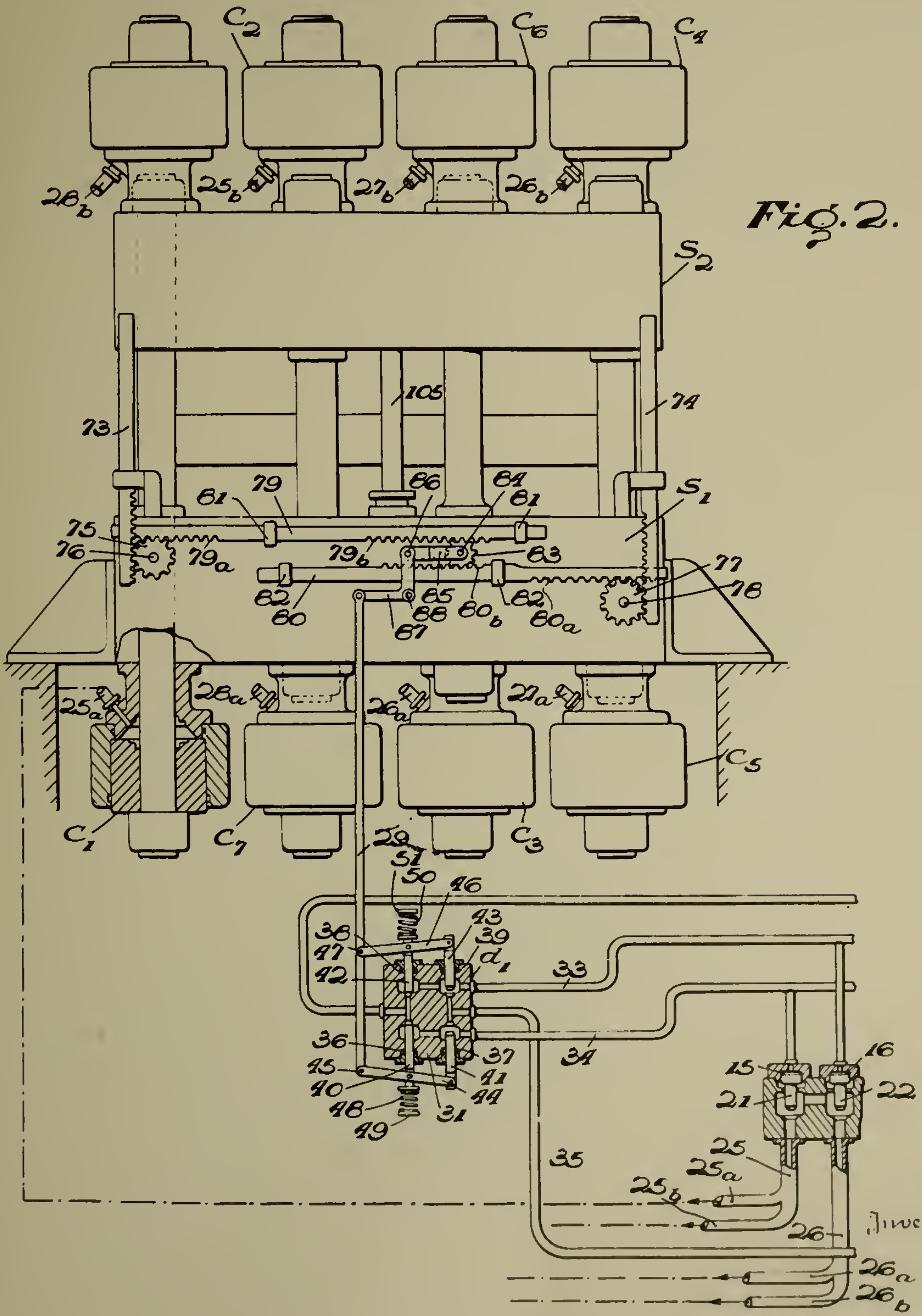

Fig. 2.

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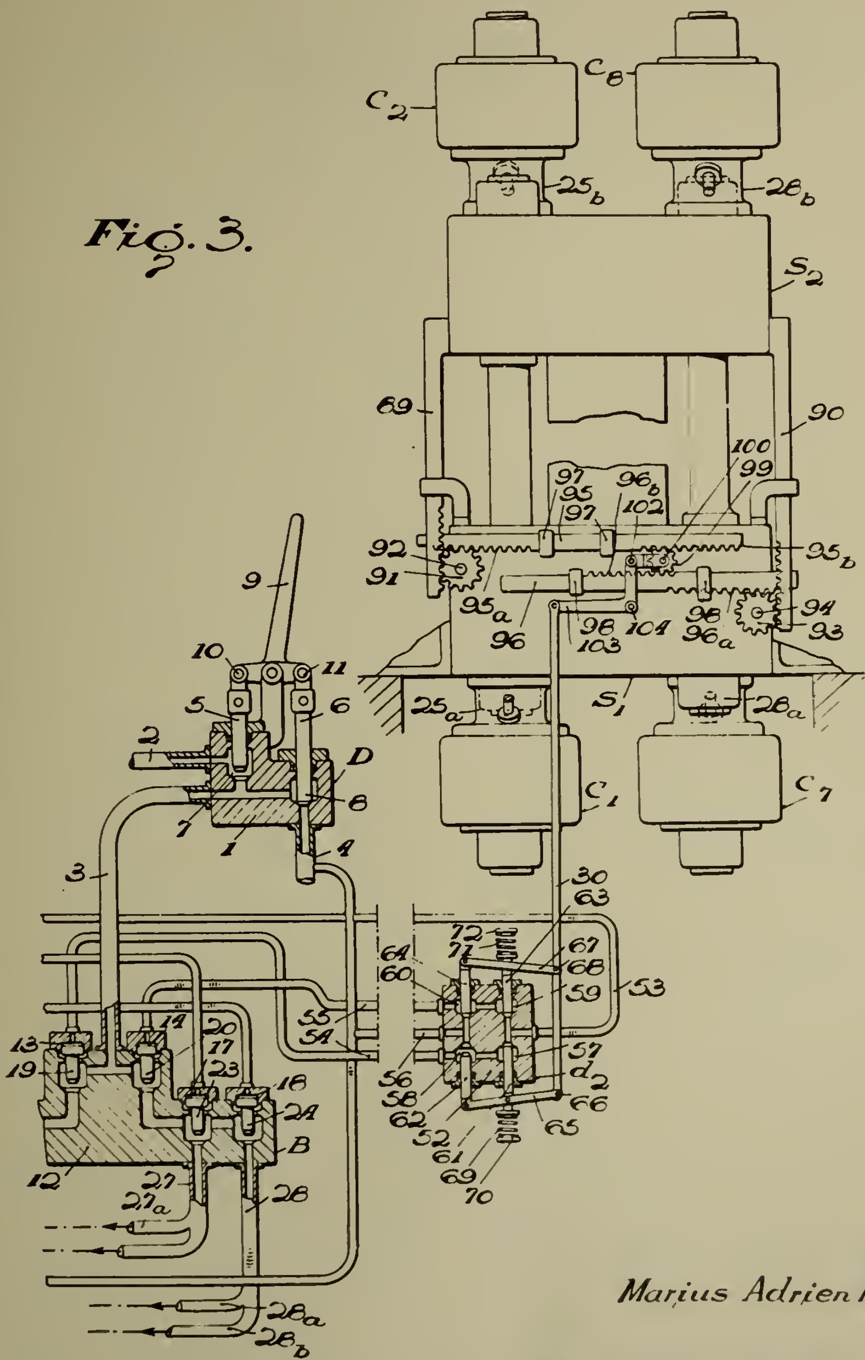
Fig. 3.



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ALIEN PROPERTY CUSTODIAN

WOODEN SOLES FOR SHOES

Raoul Marcel Laurent Issaly, La Tronche, France; vested in the Alien Property Custodian

Application filed November 9, 1942

At the present day wood is currently used for manufacturing the soles of shoes. Owing to the lack of flexibility of this material, it has been proposed to use wooden soles in which a certain amount of flexibility was obtained by providing said soles with hinges and/or springs, or by forming notches in the wooden board constituting the sole. But these arrangements have serious inconveniences; in particular they weaken the sole which might easily break; they do not take into account that the wood swells under the action of dampness which may result in an inadmissible distortion of the shoe; finally they provide soles which are not watertight and which, for this reason, must be mounted on an insole, made either of leather or other similar material.

The invention has for its object a wooden sole for shoes which is watertight and has all the desired properties of flexibility but does not offer the above mentioned inconveniences.

Said soles are constituted by wooden rods parallel to each other, at right angles to the longitudinal axis of the sole and stuck on a supporting plate made of flexible and waterproof material such as, for instance, a composition mainly made of rubber or of natural or synthetic resins.

According to another feature, the wooden rods are suitably spaced apart for allowing them to swell without distorting the sole.

According to the invention also, the wooden soles thus constituted are provided with wear resisting material housed in holes provided in the wooden rods and completely passing through the same.

The invention has also for its object a method for manufacturing the soles such as above described and which consists in utilising as support, a plate formed of a composition mainly made of rubber or of natural or synthetic resins and in applying said plate on the wooden elements by simultaneous pressure and vulcanization by means of a hot press.

For obtaining the final sole, according to the invention, the supporting plate can be cut out to the desired shape and dimensions, it can be placed in a mould, wooden rods previously cut to the required dimensions can then be arranged on said support parallel to each other by interposing between them spacing members of the same height and length constituted, for instance, by metal strips made of soft steel, the width of which is equal to that of the space which is to be maintained between the wooden rods, then after having closed the mould with a cover, the whole can be placed between the heating plates of a vulcanizing press of any known type.

According to another preferred embodiment of the invention use is made of a large wooden board, rectangular for instance, the thickness of which is that of the rods; on said board is stuck by vulcanization under pressure a supporting plate of the same dimensions; in the wooden board are cut, by means of a suitable tool such as a circular saw, parallel grooves of the required width and penetrating to the supporting layer; then, in the compound and flexible plate thus obtained, final soles are cut to the required shapes and dimensions.

In the accompanying drawings, given by way of example,

Fig. 1 is a plan view of a sole according to the invention;

Fig. 2 is a section made according to line II—II of fig. 1;

Fig. 3 is a section made according to line III—III of fig. 1;

Fig. 4 is a plan view of a sole according to the invention provided with protecting blocks;

Fig. 5 is a section made according to line V—V of fig. 4;

Fig. 6 is a plan view of a compound plate obtained by the method according to the invention;

Fig. 7 is a section according to line VII—VII of fig. 6.

Referring to the drawings, the sole illustrated in figs. 1 to 3 is composed of a supporting plate **1** made either of a composition mainly made of rubber or of natural or synthetic resins, or of fabric waterproofed by impregnation with rubber or resin, about 2.5 mm thick and on which are stuck the wooden rods 2, 10 mm wide, 7 mm thick and spaced apart to form grooves **3** about 1 mm wide. The rods **2** have different widths according to their location on the sole, those at the tip and at the heel being wider, so as to reinforce these parts of the sole.

It will be seen that this wooden sole is waterproof; it has in the longitudinal direction, the flexibility of the support **1** and the latter can serve as insole for the assemblage of the shoe which is thus greatly simplified. The space **3** left between the rods **2** allows the latter to swell under the action of dampness without producing the distortion of the sole and of the shoe on which it is secured.

The assemblage on the shoe can be effected by stitching, sticking or nailing. Said sole can also be mounted by milling its edges on the tread side at **4** and by securing on the milled part a welt

made of leather or rubber which protects the edges of the wooden elements 2 and allows the sole to be stitched on the welt of the shoe.

In figs. 4 and 5 a similar sole has been illustrated provided with blocks 5 made of wear resisting material such for instance as rubber or plasticized polyvinyl chloride. Said blocks 5 which completely pass through the rods 2 in holes provided for that purpose can form part of the support 1 or be stuck thereon.

Owing to this arrangement the sole wears uniformly and much less rapidly, the protecting material being present until it is completely worn out.

For manufacturing soles such as those above described, the following method can be adopted:

In a mould of suitable shape is arranged a plate having the shape of the final sole and of a composition mainly made of rubber or of resins; on said support are arranged the wooden elements parallel to each other and at right angles to the longitudinal axis and between each two successive elements is interposed a metal strip made of soft steel having the same length and height as the adjacent elements and a width equal to the free space to be reserved between said elements. The mould is closed and placed between the two plates of a vulcanizing press. When the vulcanization is terminated the sole is removed from the mould, then the metal strips are removed. It will then be seen that the wooden rods adhere perfectly to the support and that a sole is obtained such as that illustrated in Figs. 1 to 3.

The following method might also be adopted: instead of using a mould of small dimensions having the shape of the sole, use is made of a mould of large dimensions and of simple shape; for instance a rectangular mould and in said mould is arranged a supporting plate 6 of the same shape on which are placed rectangular wooden rods 7 the length of which is equal to one of the dimensions of the mould and of the support and the width and thickness of which are equal to those of the wooden elements of the sole to be obtained. Between each two successive wooden rods 7 is introduced a metal strip. After vulcanization between the plates of a press and removal of the metal strips, a compound plate is obtained such as that illustrated in Figs. 6 and 7 comprising a supporting plate 6 on which are stuck wooden rods 7 separated by intervals 8. It is then simply necessary to cut out, according to the dotted lines 9 with a suitable tool, the soles to be obtained, as is done in a hide for leather soles.

According to another preferred method of carrying out the invention, the following operations are effected: on a plate of a composition mainly made of rubber intended to serve as support, is stuck by vulcanization under pressure or by means of a suitable solution, a sheet or board of wood having a thickness equal to that of the elements of the sole to be obtained. Once said compound plate obtained, it suffices, by means of a tool, composed for instance of a number of circular saws secured on one shaft, to cut out in the thickness of the wood parallel grooves extending through to the surface of the rubber and having a width of the order, for instance, of 1 mm. A plate similar to that illustrated in Figs. 6 and 7 is then again obtained.

By simply modifying the interval between the various circular saws, it is possible to obtain more or less wide wooden elements according to the place they are to occupy on the sole to be manufactured. By the same method, a final sole can also be immediately obtained; the sole having been cut out to the required shape in a wooden board and the support of the same shape having been stuck, parallel grooves are cut in the wooden sole by means of a circular saw.

For obtaining a sole such as that which is illustrated in Figs. 4 and 5, use can be made of any one of the above described methods, care being taken to provide in the wooden elements, holes which completely pass through them. In order to insert in said holes blocks of wear resisting material, one or the other of the following methods can be adopted:

The holes being formed in the wooden rods or the board, rubber cylinders are forcibly inserted therein, having a diameter slightly greater than that of the holes which allows them to adhere to the wooden elements. This adherence to the sole is moreover increased when the support is stuck on the wooden elements, as the support is then also stuck on the internal base of the cylinders.

According to another embodiment, the holes being formed in the elements and the latter as well as the support being placed in the mould before vulcanization under the sole action of heat and pressure when said vulcanization is effected, the rubber of the support penetrates into the holes and fills them up and the wear blocks thus constituted are formed of vulcanized rubber forming an integral part of the support.

For further improving the wear resisting property of the sole, on the tread side of the wooden elements can be stuck a sheet made of a good wear resisting material, such as polyvinyl chloride. This supplementary application can be effected at any moment of the cycle of manufacture.

The repairing of the soles obtained by any one of the above described methods can be very simply and rapidly effected in the following manner: all the worn wooden rods are removed and replaced by new rods of the same length and of suitable thickness which are, either stitched by hand, or stuck and nailed.

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PUBLISHED

JUNE 1, 1943.

BY A. P. C.

R. M. L. ISSALY

WOODEN SOLES FOR SHOES

Filed Nov. 9, 1942

Serial No.

465,944

2 Sheets-Sheet 1

Fig. 1

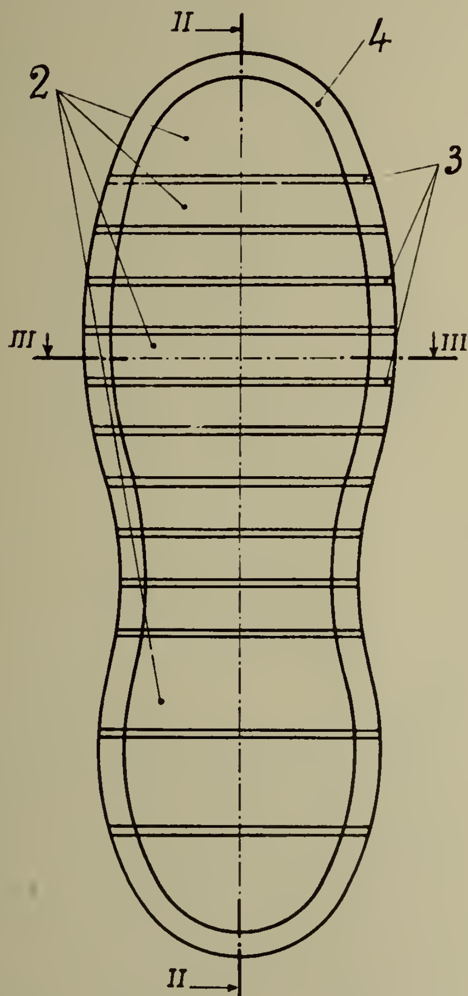

Fig. 2

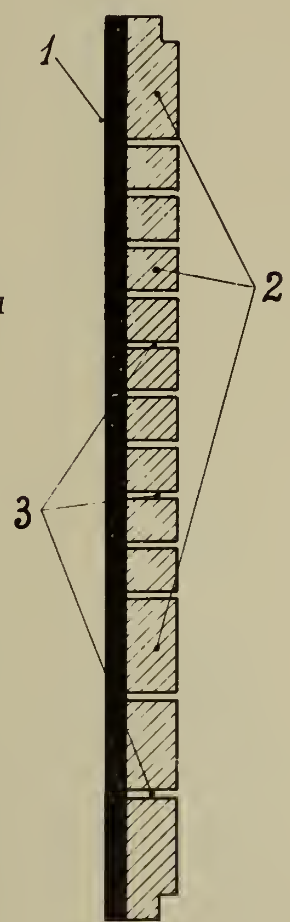

Fig. 3

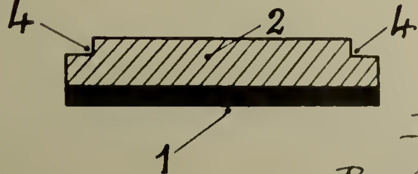

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Fig. 4

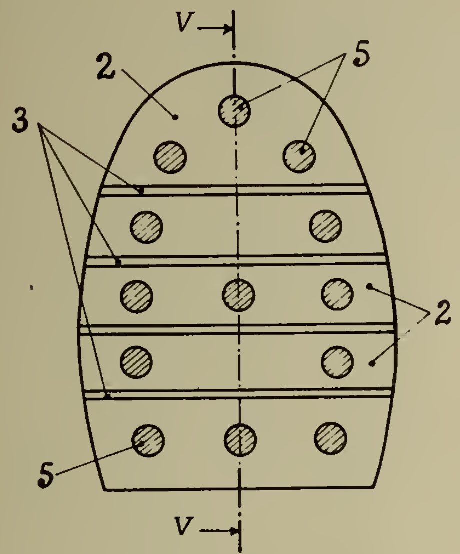


Fig. 5

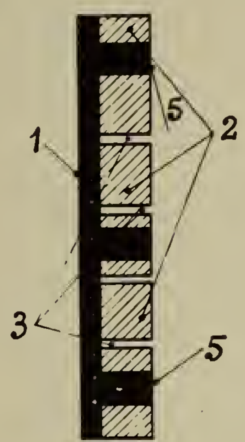


Fig. 6

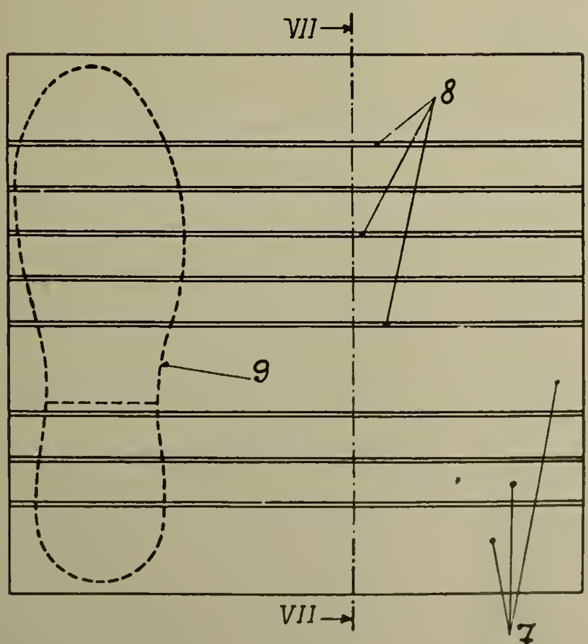
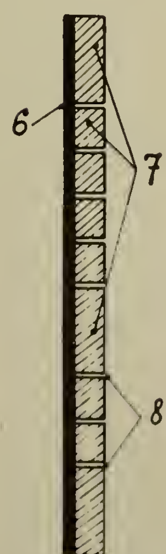


Fig. 7



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CHANGE SPEED DEVICES BY MEANS OF A WHEEL OF VARIABLE DIAMETER

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Application filed November 9, 1942

The present invention has for object a change speed device by means of a wheel or pinion of variable diameter applicable to transmissions of the type of chain, belt or cable transmissions and comprises in particular the following features:

The wheel of variable diameter is composed of movable independent elements capable of assuming successive concentric positions, all these elements being, for each position, on one and the same circle and the passage from one position corresponding to a circle of given diameter to another position corresponding to a circle of greater or smaller diameter being produced by the spacing apart or the approaching of two at least of the movable elements.

In the case of a chain transmission having a definite pitch, the movable elements each carry teeth and they are arranged in such a manner that, when they are in the position corresponding to the circle of minimum diameter, they are all in contact with each other and form a continuous pinion in which the constant space separating the teeth is equal to the pitch of the chain.

According to another feature the movable elements can be held stationary in a certain number of definite positions corresponding to circles the lengths of the circumferences of which are equal to a whole number of pitches, the passage from one circle to the circle immediately larger or smaller being produced by the spacing apart or the approaching of two at least of the movable elements to a distance equal to the difference in length of the two circles, said movable elements then forming a discontinuous pinion, but the space separating two adjacent movable elements being always equal to zero or to a whole number of pitches.

The movable elements are arranged in two groups of side plates which are mounted on the shaft of the device and can have relative angular displacement with respect to each other, said side plates carrying sloped inclines in which are engaged studs rigid with the movable elements, the inclines of one of the groups of side plates having a slope in reverse direction to those of the other group, so that an angular displacement of one of the groups of side plates relatively to the other produces both a radial and angular displacement of each movable element.

Both groups of incline-carrying side plates can be operatively connected as to rotation when the movable elements are in a definitive position corresponding to a whole number of pitches and can have relative angular displacements for the passage of the movable elements from one position to another.

Other features will appear from the following description in the course of which it will be convenient to call working length, a definitive position of the movable elements on a circle of definite diameter, corresponding consequently, to a given speed.

In the accompanying drawing, given by way of example:

Fig. 1 is a half-view with partial section according to line I of Fig. 2 of the device according to the invention when the movable elements have the minimum working length;

Fig. 2 is a section according to line II of Fig. 1;

Fig. 3 is a half-section with partial section according to line I of Fig. 4 of the device when the movable elements have the maximum working length;

Fig. 4 is a section according to line II of Fig. 3;

Figs. 5 to 10 are views showing separately members of the apparatus;

Figs. 11 to 13 are diagrams of the operation of the control device;

Figs. 14 to 26 show constructional modifications of various members of the apparatus;

Figs. 27 to 39 are diagrammatic views showing modifications of operation.

According to the embodiment illustrated in Figs. 1 to 4, the change speed device for a chain transmission according to the invention is composed of two spool-shaped members **1** and **2** fitting into each other, the member **1** comprising two parallel side plates **3** and **4** rigidly mounted on the shaft **5** of the transmission and member **2** comprising two parallel side plates **6** and **7** loosely mounted on the shaft **5**, internally adjacent to the side plates **3** and **4** and connected together by pins **8**. In the side plates **3** and **4** are cut out slots **9** different from each other but parallel on both side plates, and in the side plates **6** and **7** are also cut out slots **10** which will be hereinafter called inclines, the inclines **10** being sloped in reverse direction to the slots **9**. Between the side plates **6** and **7** are arranged movable elements **11** (see also Fig. 8) each comprising two teeth **12** spaced apart to a distance p equal to the pitch of the chain used (not shown). Said elements **11** are so constructed that when two of them are in contact, the distance between one tooth of one and the adjacent tooth of the other is equal to p. Each element **11** comprises two lateral parallel lugs **13** in contact with the inner faces of the side plates **6** and **7** and two studs **14** and **15** secured at the ends of element **11** on each of the lugs **13** at the

level of the pitch circle E and penetrating, one into an incline 10 and a slot 9 of the side plates 6 and 3 and the other in the corresponding incline and slot of the side plates 7 and 4.

In the example illustrated in Figs. 1 and 3 has been chosen the case of a change speed device having a minimum working length of 16, that is to say corresponding to a pinion having 16 teeth formed by eight elements 11 each having two teeth and adjacent to each other (Fig. 1). The number of slots 9 and inclines 10 of each of the side plates 3, 4, 6 and 7 is therefore eight. The maximum working length chosen is 24 and corresponds to a discontinuous pinion having eight empty spaces each equal to a pitch p and the space separating the adjacent teeth of two elements spaced from each other being then $2p$. In this case the total number of possible working lengths is nine, each working length differing from the preceding one by a spacing apart equal to p and each slot or incline being formed by a broken line comprising eight straight lines end to end, the intersection of two straight lines corresponding to a given working length.

The slots 9 and inclines 10 are traced in such a manner that the points where the slots and inclines cross each other for any given position are always all on one and the same circle and so that the passage from a working length r to the working length $r+1$ determines the spacing apart of two adjacent elements 11 to a distance equal to a pitch p.

At both ends of one and the same diameter of the incline-carrying side plate 7 are provided two bosses 16 and 17 each comprising a notch 18 and 19, and on the periphery of the slot-carrying side plate 4 are provided notches 20 equal in number to the number of working lengths provided, that is to say nine in the case chosen.

Against the side plate 4, and loosely mounted on the transmission shaft 5, is arranged a cheek 21 (see Fig. 9) carrying at both ends of a diameter two lugs 22 and 23 constantly in engagement with the notches 18 and 19 of the side plate 7 and capable of entering the notches 20 of side plate 4. The cheek 21 will be called hereinafter: the lug-carrier. The lug-carrier comprises at its centre a slot 24 allowing it to have a radial sliding movement relatively to shaft 5.

The radial movements of the lug-carrier 21 are obtained by the passage of one or the other of the lugs 22 and 23 on a cam 25 (Figs. 5 and 6). Cam 25 is rockably mounted about a spindle 26 secured by a nut 27 on a small plate 28 rigid with the main frame of the apparatus. The movements of cam 25 are controlled by a hand-lever 29 connected to said cam through the medium of a Bowden cable 30 attached to a spring 31 secured in its turn at its other end on a tongue 32 rigid with cam 25, the movement of the tongue 32 being limited by means of two abutments 33 and 34, and a spring 35 constantly tending to restore the tongue against the abutment 33. The spring 31 acts only when the hand-lever 29 is pushed in the direction of the arrow f and it then tends to cause cam 25 to rock about its spindle 26 in the direction of the arrow F and to press the tongue 32 against the abutment 34. The spring 35 acts, on the contrary, when the hand-lever 29 is released and then tends to cause cam 25 to rock in the direction of the arrow G and to press tongue 32 against the abutment 33.

The dimensions and shape of cam 25 and its position are such that when tongue 32 is pressed against abutment 33, the cam is located between the two paths followed by the two lugs 22 and 23, the lug following the circle of larger diameter passing above the cam 25 without entering in contact therewith (see Fig. 11) and the lug following the circle of smaller diameter passing under cam 25 (dead centre position). When tongue 32 is pressed against abutment 34 (engagement position) cam 25 is on the path of the lug following the circle of smaller diameter when the lug-carrier rotates in the direction of the arrow F^1 (see Fig. 12) and on the path of the lug following the circle of larger diameter when the lug-carrier rotates in the direction of the arrow G thus causing a lifting of the lug-carrier 21 in the first case and a lowering thereof in the second case.

The operation of the device is as follows:

Let us assume that the whole of the transmission operates at the minimum working length, that is to say the working length 16, illustrated in Fig. 1. In this case all the movable elements 11 are in contact, forming a continuous pinion and the studs 14 and 15 are located at the ends of the inclines 10 and slots 9 nearest to shaft 5, lug 22 is engaged in the bottom of notch 18 and one of the notches 20, both members 1 and 2 are rendered rigid together and rotate with shaft 5 in the direction of the arrow F^1, lug 22 following the circle of smaller diameter. If it is then desired to pass to working length 17 immediately higher, the hand-lever 29 is actuated in the direction of arrow f and cam 25 rocks in the direction of arrow F (Fig. 6).

If the first lug which passes opposite cam 25 is lug 23 which follows the circle of larger diameter, it passes on the upper half of the cam causing it to rock, spring 31 allowing this movement without having to abandon the hand-lever 29, and nothing takes place. On the contrary, as soon as lug 22 passes opposite cam 25 (Fig. 13) it abuts against the latter, it is then lifted and disengages from notch 20 of disc 4, the lug-carrier 21 is lifted in its turn to the same amount and the opposite lug 23 takes a bearing on the periphery of side plate 4. Lug-carrier 21 is then wedged and stops, which simultaneously causes the stoppage of member 2 constantly connected thereto, member 1 continuing to rotate with shaft 5. As soon as a notch 20 of disc 4 is opposite lug 23, the latter which was firmly pressed against the periphery of disc 4, enters said notch, members 1 and 2 are then again rendered rigid together, lug 22 can continue its movement riding up on cam 25 and pass beyond it, causing it to rock against the action of spring 31 and, if the hand-lever 29 is abandoned, said cam 25 then comes back under the action of spring 35 to its dead centre position.

During this operation, the movement of the movable elements was as follows: As soon as both members 1 and 2 are no longer operatively connected as to rotation and as member 2 is stopped, member 1 continuing to rotate, said members perform a relative angular movement with respect to each other, the points where the slots 9 and inclines 10 cross each other are displaced, which determines a displacement of studs 14 and 15. The elements 11 have followed said movement by remaining constantly on one circle for each intermediate position and they remain in contact with the exception of two which are spaced from each other, since the circles corresponding to the intermediate positions have increasing diam-

cters and the number and dimension of elements 11 are invariable. Consequently one of the elements 11 has moved according to a radius, the adjacent element, in the reverse direction to the direction of rotation, has been simultaneously subjected to a radial displacement equal to the preceding one and a slight angular displacement in the direction of rotation, the following element to a radial displacement, always constant, and to an angular displacement slightly greater, and so on, up to the last element which has been subjected to the maximum angular displacement. The notches 20 are arranged at the periphery of side plate 4 so that the relative movement of members 1 and 2 determining the passage from the position corresponding to the engagement of lug 22 in one of the notches 20 to the following position corresponding to the engagement of lug 23 in another notch 20 determines an angular displacement of element 11 which has moved away from the adjacent one, such that the total movement which has taken place spacing apart these two elements is equal to a pitch p.

On the other hand, it will be seen that it is sometimes lug 22 which enters in one of the notches 20, sometimes lug 23; both said lugs being diametrally opposed, the notches 20 are distributed on two opposite sectors of circles; the notches corresponding to the odd working lengths 17, 19, 21 and 23, being arranged on one of the sectors and the notches corresponding to the even working lengths 16, 18, 20, 22 and 24 being arranged on the other sector.

On the other hand also, it is important that it should not be the same two elements 11 which are spaced from each other for each working length and, on the contrary, it is desirable that, at maximum working length, each element should be spaced from the adjacent element according to a distance equal to a pitch p; this is easily obtained by tracing the slots 9 and inclines 10 in such a manner that for each change of working length it is a different element which is subjected only to a radial displacement corresponding to a radial element of incline 10 of member 2 and, for balancing the various pinions thus obtained, provisions will be made so that two successive radial elements of inclines 10 corresponding to two successive changes of working length are located on two opposite sectors of circle.

Finally it is to be noted that, in the case of a transmission having teeth and chain, it is indispensable that, at the time the working length is changed, the progressive spacing apart of two movable elements should take place in the part of the pinion which is not in contact with the chain, as the elements in mesh with the chain cannot obviously move away from each other. This result is obtained by suitably disposing relatively to the inclines 10, the diameter on which the two notches 18 and 19 are located, the position of said diameter determining the sector in which the elements 11 will be spaced apart.

If it is desired to effect the operation reverse to the preceding one, that is to say, to pass from working length r to working length $r—l$, the following method will be adopted:

Cam 25 having been actuated by means of the hand-lever 29 and being in the position of engagement of Fig. 12, the transmission shaft 5 will be simultaneously given a movement of rotation in the direction of the arrow G^1, the lug-carrier 21 then rotating in the same direction, the passage of lug 22 following the circle of small diameter opposite cam 25 will produce no change, but as soon as lug 23 following the circle of large diameter will come in position it abuts against the lower face of cam 25 which will tend to cause it to lower and, pushing it downwardly, will press it against the periphery of disc 4 and will cause the opposite lug 22 to come out of the notch 20 in which it was engaged. The lug-carrier 21 and member 2 are then held stationary, member 1 continuing to rotate in the direction of the arrow G^1. Members 1 and 2 then have a relative movement in the reverse direction to that of the preceding case and elements 11 then move in the direction for passing from a circle of a given diameter to the circle of smaller diameter, both elements 11 which were spaced apart to a distance p in the preceding case, returning in contact with each other. As soon as lug 23 can enter another notch 20, the discs will again be rendered rigid together and shaft 5 can re-assume its driving movement in the direction of the arrow F^1.

In the example described, it has been assumed that the elements 11 have two teeth, it is obvious that said elements might comprise a single tooth (Fig. 7) or three or even more.

The case of a change speed device having nine speeds has also been described, but it is to be understood that the number of speeds depends on the successive supplementary intervals created from the initial position.

For instance, a mechanism of 18 teeth constituted by single-tooth movable elements, will correspond to a pinion having 36 teeth when each tooth will have moved one step away from its adjacent teeth, and to a pinion of 72 teeth when each tooth will have moved two steps away from its adjacent teeth.

For equivalent intervals, a mechanism having 18 teeth constituted by movable elements each having two teeth, will successively correspond to 27 and 36 teeth, passing of course, through all the intermediate positions. If this same mechanism of 18 teeth is constructed in groups of three teeth, it will correspond to 24 teeth after each element has moved one step away and to 30 teeth when each element has moved two steps away.

Whatever may be the fractionation chosen for the movable members the choice of which will be determined by the considerations of utilisation, there are many speeds as there are spacing teeth or pitches, plus one. Thus a 18/36 mechanism has 19 successive speeds corresponding to the offsetting of one tooth at each change of working speed.

In Figs. 14 to 17 has been shown a modification of assemblage of the movable elements 11 and members 1 and 2. In this case the assemblage is obtained by means of double-headed studs 36 entering corresponding holes 37 formed in the lugs 13 of element 11 and 38 formed in one of the ends of slots 9 and inclines 10 and to which they are connected by a short slot 39. The assemblage is effected by bringing the studs 36 opposite the various holes and inserting them therein, then by again imparting to both members 1 and 2 a relative movement so as to restore the studs 36 to the normal starting point.

In the case of rustic mechanisms having only slight torques to transmit, the movable elements can be constructed such as they are illustrated in Fig. 18, that is to say by doing away with the lateral lugs and by placing the studs 14 and 15 directly in the heel-piece 40 of the teeth.

In Fig. 19 has been shown a constructional

modification of the inner member 2 which is then made in one piece and comprises flanges 41 and 42 in which are provided suitable cut-away parts 43 and 44 allowing the introduction of the movable elements 11 when the latter comprise studs 14 and 15 rigid therewith.

In Fig. 20 has been shown a constructional modification of movable elements of small dimensions in which the lateral studs are formed by sheets of thin resilient steel allowing the elements to be placed in position by pinching them.

In Fig. 21 have been shown members 1 and 2 provided with flanges 45 and 46 intended to increase the rigidity thereof. For further increasing said rigidity and at the same time for protecting the structure from dust, the slots 9 of disc 1 can be simply stamped and need not open to the exterior.

Said slots 9 as well as the inclines 10 can be slightly extended at both their ends for collecting and evacuating the foreign bodies which might be introduced in said slots.

In Figs. 22 and 23, methods of construction of the movable elements have been shown, in the case of a belt or cable transmission. In this case said elements instead of having teeth comprise a smooth groove.

Also in the case of a smooth belt or cable transmission and when the stresses to be transmitted are small, the slots 9 and inclines 10 can be constituted by simple identical arcs of circle (Fig. 24). In this case, the eccentricity of the movable elements is uniform during a change of working length, all the elements moving away or approaching each other to the same amount, which can only apply, as indicated above, to the case of a small load since even the elements under the belt must move relatively to each other. In this case, changes of working length as gradual as desired can be obtained by increasing the number of notches 20.

Owing to the dimensions of cam 25 the location of the points where the movable elements move away from each other, can be somewhat different according as the change of working length takes place in one direction or in the other, that is to say, as the cam 25 is attacked by one of the lugs at one or the other of its ends. This can constitute an inconvenience when the path out of contact with the chain or belt is small (case of an enveloping chain or belt with a returning wheel). In this case it will therefore be advantageous for the cam to be always attacked at the same point, whatever may be the direction of rotation. This result is obtained by means of the device of Fig. 25 in which the cam is replaced by two cams 50 and 51 controlled by a single lever 52 to which they are connected by links 53 and 54, the half-cam 51 being used by lifting in the case in which the change of working length takes place with a rotation in the direction of the arrow F^1 and the half-cam 50 being used by lowering in the case of change of working length with a rotation in the direction of the arrow G^1.

In Fig. 26 has been shown a device allowing of avoiding the change of the direction of movement before cam 25 is passed which might determine the locking of the mechanism. For remedying this inconvenience two fixed cams 55 and 56 are arranged on either side of cam 25 and form with the latter, when it is in position of engagement two channels 57 and 58 in one of which is compulsorily engaged the lug which must determine the operation. These fixed cams have the effect of restoring the lug 22 or 23 to the position it occupied on or under cam 25 before coming in engagement therewith if the direction of the movement is changed before the lug under consideration has completely passed cam 25.

In all the foregoing, it has been assumed that the change speed device according to the invention was mounted as a driving wheel of the transmission. It is obvious that said device might be applied as such, as a driven wheel, the actuation being then produced by the chain itself instead of being produced by the driving shaft 5 and one of the spool-shaped members, for instance the slotted member 1 being connected to the driven shaft by a free wheel device.

In this case, as member 1 is only connected to shaft 5 when the device rotates in the direction of arrow F^1, it will be possible to effect changes of speed in both directions without having to change the direction of rotation; in fact it suffices to hold one or the other of members 1 and 2 stationary for the working length to pass to the higher working length or the lower working length.

This result is obtained as diagrammatically illustrated in Figs. 27 to 32 by providing the device with two half-cams 60 and 61 controlled as cam 25, the half-cams 60 playing the same part as cam 25 for passing from working length r to working length $r+1$ by braking member 2 and the half-cam 61 cooperating with a projection carried by member 1. The surface of cam 61 which can rock about the spindle 63 is divided into three parts: an incline AB, a circular part BC having as axis, the general axis of rotation when cam 61 is in position of engagement and a nose CD. Let us assume that the device constantly rotates in the direction of arrow F^1, the changes of working length in the direction for passing from working length r to working length $r+1$ take place by stopping member 2 by means of cam 60, as indicated above for cam 25. If it is desired to return from working length $r+1$ to working length r, cam 61 is placed in engagement (Fig. 28). As soon as lug 22 which, for instance, is that which is then engaged in one of the notches 20, comes in position, it rides up the incline AB, and causes cam 61 to rock about the spindle 63 and as soon as the projection 62 comes in position in its turn, it abuts against the end of cam 61 at the moment lug 22 has reached B and is disengaged from the notch 20 in which it was housed (Fig. 29). Member 1 is then stopped and member 2 continues to rotate while lug 22 follows the circular path BC. During this time, another notch 20 has come in front of the opposite lug 23 which has engaged therein and lug 22 can then ride up on the incline CD and pass over cam 61 by causing it to rock in the reverse direction to the preceding one and thus releasing the projection 62 which allows members 1 and 2 operatively connected together by lug 23, to resume their common movement.

In Figs. 33 to 35 have been shown various modifications of the profiles of members 1 and 2 allowing to increase the progressivity and the smoothness of the change of speed.

In Fig. 33 is diagrammatically shown the most simple profile. The incline-carrying member 2 has two diametrally opposed slots 18 and the slotted disc 1 a series of notches 20. The lug 22 passes from one notch 20 to the other completely immobilising member 2 at the moment the working length is changed.

In Fig. 34, the general arrangement is the same but the notches of the slotted member are joined, not by a circular portion as in Fig. 33, but by bosses 64. Lug 22, instead of completely stopping the incline-carrying member 2 at a definite point, will have a slight displacement on the cam due to the height of the boss 64 and instead of the member 2 being completely held stationary during the change of speed it will be simply braked relatively to the slotted member. This method allows a smoother change of speed.

In Fig. 35 is shown a device allowing a more important movement of both members 1 and 2 during the change of working length and therefore a gearing-down allowing greater smoothness. Instead of the incline-carrying member 2 being provided with only two diametral slots, it can also be divided by notches 65. The distance between the notches 65 of member 2 less the distance between the notches 29 of member 1 represents the relative movement necessary for the changes of working length.

When a transmission having wheels of variable diameter is at its minimum working length or at its maximum working length, the engagement of the cam will have for consequence a prejudicial shock to the mechanism. A device illustrated in Figs. 36 to 39 prevents the cam from coming in engagement even when the control thereof is actuated.

The lug-carrier 21 is provided with a stud 66 which, in its normal position, at all the intermediate speeds, is not located in the zone of the cam. In Fig. 37 will be seen the mechanism at an intermediate working length. The operation is normal, lug 22 and with it the lug-carrier, is about to be lowered by cam 25 and the change of length will take place.

In Fig. 38, the mechanism is illustrated at one of the two extreme working lengths and rotating in the direction of the arrow G^1. The stud 66 has been lifted by a boss 67 carried by a flange 68 rigid with the slotted member 1. In this new position, stud 66 causes cam 25 to rock (which cam is connected to its control by a spring allowing said movement even when the control lever is maintained in position) at the moment lug 22 comes in position and the latter goes beyond the cam by passing over it.

If the movement takes place in reverse direction (Fig. 39) then it is lug 22 which causes the cam to rock just before the passage of stud 66, in other words, stud and lug mutually cancel the cam.

For the other extreme working length, it is the other diametral end of the lug-carrier which carries a cancelling stud placed in position at said latter working length by another boss carried by the flange.

The boss 67 can be replaced by a slot provided in the same flange and putting in engagement, at the required moment, one or the other of the cancelling studs for the extreme working lengths.

The change speed device according to the invention can be applied to all transmissions of the chain, belt or cable type and in particular on bicycles, and it is mounted in combination with a chain or belt-tightener of any known type.

The device can also be mounted both on the driving wheel and on the driven wheel which can allow the chain-tightener to be done away with when the diameters of both wheels vary simultaneously and in reverse direction.

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PUBLISHED

JUNE 1, 1943.

BY A. P. C.

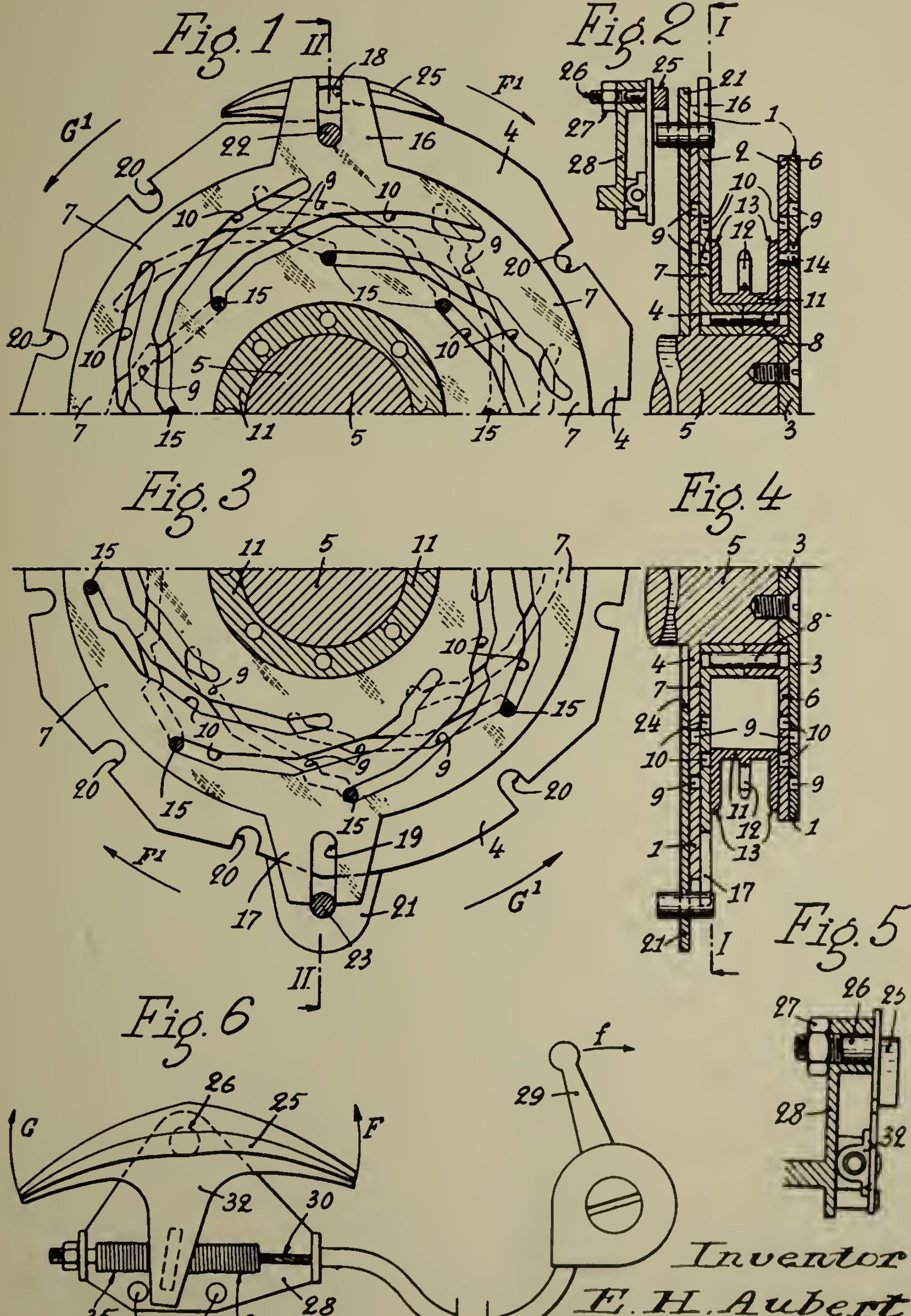
E. H. AUBERT

CHANGE SPEED DEVICES BY MEANS OF A WHEEL OF VARIABLE DIAMETER

Filed Nov. 9, 1942

Serial No. 465,945

4 Sheets-Sheet 1



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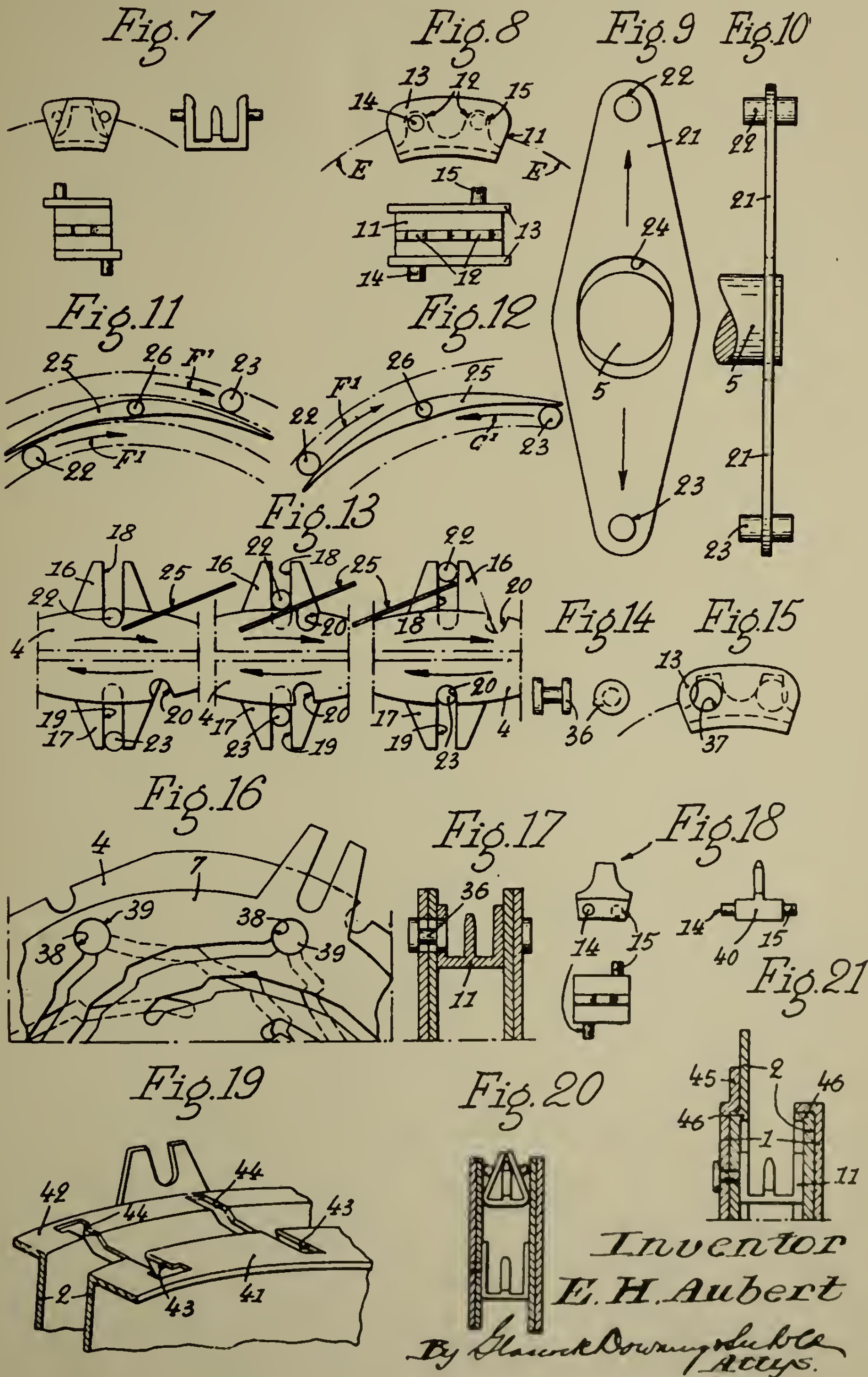
4 Sheets-Sheet 2



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465,945

4 Sheets-Sheet 3

Fig. 24

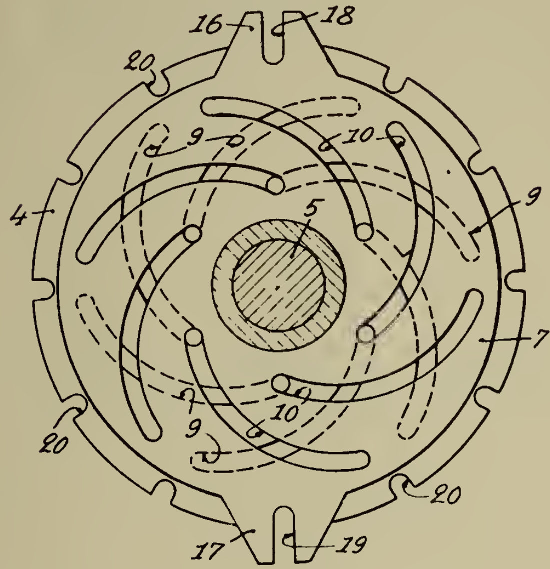


Fig. 22

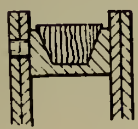


Fig. 23

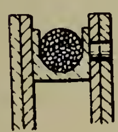


Fig. 25

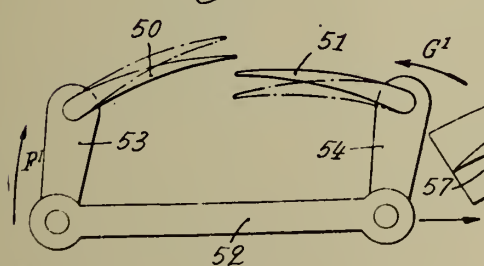


Fig. 26

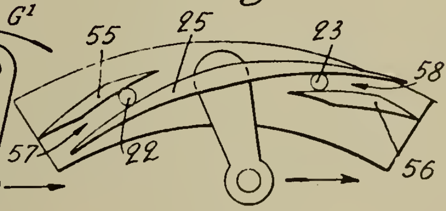


Fig. 29

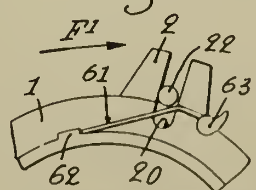


Fig. 27

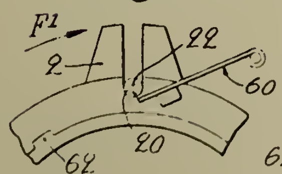
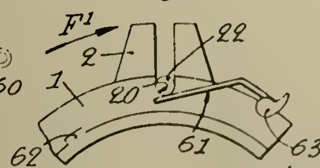


Fig. 28



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4 Sheets–Sheet 4

Fig. 30

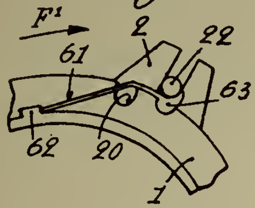


Fig. 31

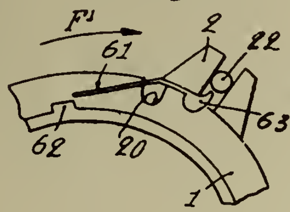


Fig. 32

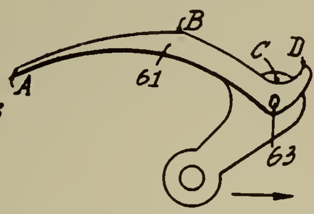


Fig. 33

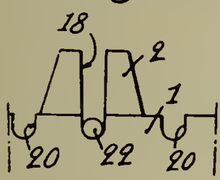


Fig. 34

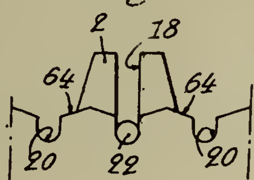


Fig. 35

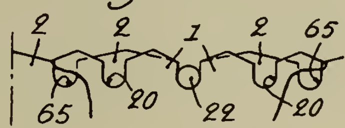


Fig. 36

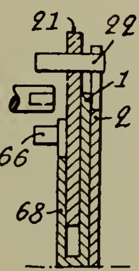


Fig. 37

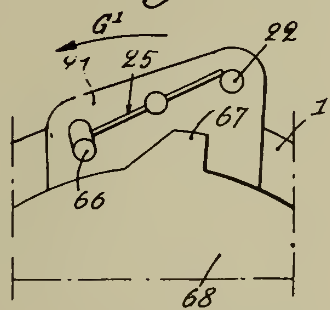


Fig. 38

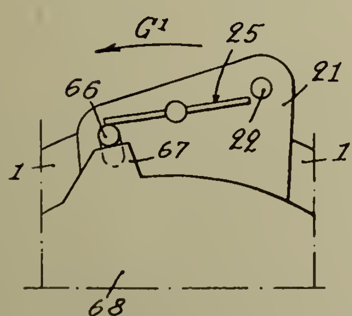
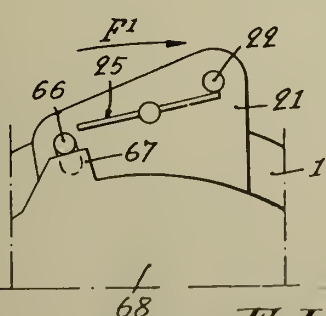


Fig. 39



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ALIEN PROPERTY CUSTODIAN

LOCAL ANAESTHETICS

Jean Regnier, Paris, France; vested in the Alien Property Custodian

No Drawing. Application filed August 3, 1934

At the present time, alkaloids and in particular local anaesthetics are most generally used in the form of their salts of mineral acids, as at the time of their discovery.

However, for some years, it has been endeavored to utilize other salts, prepared with acids weaker than mineral acids.

These endeavours are based, among other searches, on those of Overton (Vierteljahresschr. d. Naturf. ges. Zurich 1896, 41 383; 1899 44 88), of Ruhland (Yahrber. Bot. 1914 54 391), of Tröndle (Biochem. Ztschr. 1920 112 259) and chiefly, in the present case, of Oscar Gros (Arch. f. exp. path. u. pharm. 1910, 62, 380; 1910 67 126).

From the studies of these authors, the following deductions can be made: When an aqueous solution of a salt of an alkaloid is caused to act on a living cell, only the alkaloidic base is active; the acid that salifies this base would then have no other function than to permit of dissolving the alkaloid in water. If, therefore, it is admitted, as it was admitted by the authors above referred to, that only the base is active (which, by the way, was also in accordance with the hypothesis, which was then admitted, of a lipoidic layer at the surface of the cell (Meyer-Overton)) one is led to consider, as these authors did, the utilization of the salts of weak acids.

As a matter of fact, for O. Gros, in particular:

The weaker the acid, the more complete will be the hydrolysis of the salt and, consequently, the greater the amount of the base set free.

On the other hand, for other authors, such as Copeland:

The weaker the acid, the lesser this acid, set free by hydrolysis, will be ionized, and the lesser the number of hydrogen ions set free, which are detrimental of a good anaesthesis.

On the basis of these principles, tests were made, after Oscar Gros, of mixtures of cocaine chlorhydrate novocaine chlorhydrate, etc., with salts of weak acids, such as sodium carbonate, sodium bi-carbonate, sodium acetate, and the following salts were prepared and applied: dextro acid tartrate of pseudococaine (or psicaine) dextro formiate of pseudococaine (or delcaine), carbonate of novocaine (or carbaine), borates of various local anaesthetics (or borocaines).

Although the experiments above referred to were performed several years ago, it does not seem that these ideas gave rise to particularly advantageous practical results. So much so that local anaesthetics prepared recently, such as "Butyne" are salts of a strong acid, to wit sulphuric acid. The failure of the various experiments that have been made is due not only to a bad conception at the origin, as it will be hereinafter explained, but also to practical difficulties of utilization. Thus, concerning more particularly the solutions that were proposed by Oscar Gros, the fact that these solutions, due to their alkalinity, which is detrimental of a good preservation of the alkaloid, could not be prepared in advance and sterilized, but had to be prepared immediately before being used, constituted a technical complication which was not negligible.

An analogous remark is applicable also to some salts of weak acids, such as borates, the aqueous solution of which has a pH which is alkaline or too near to neutrality, such a pH being unfavorable to a normal sterilization and to a normal preservation. The lack of success in some clinical cases in the use of these salts of weak acids of local anaesthetics can perhaps be attributed to these phenomenons.

The object of the present invention is to produce salts of alkaloids, and in particular salts of local anaesthetics, permitting to obtain physiological results wholly out of proportion with the results to which the conceptions above stated could lead.

As a matter of fact, while the authors above mentioned believed that only the alkaloidic base acts on the cell, it is proved, by the present invention, that the whole of the salt of alkaloid is active.

The consequence of the present invention is to be conducive to choosing salts that are not necessarily salts of weak acids, as advised by the authors above mentioned, but that are capable, owing to some of their properties, of improving the action of the salt. These essentially favorable properties are the following: tensio-activity, easy adsorbability, properties of dissolving substances that are not hydrosoluble, considerable increase of the hydratation of the proteins with, as a consequence, a favorable modification of the cellular charge, of the swelling of the limiting cellular layers or other phenomenons facilitating the penetration into the cell.

The facts, successively discovered, that have led to the present conception, are briefly stated as follows:

In 1923, 1924 and 1925, Régnier (C. R. 4 Aout 1924, 355; B. Sc. Pr. 31, 1924, 513; Thèse doct. ès sciences Paris 1925, imprim. André Brilliard à St-Dizier) finds the favorable influence, concerning anaesthesis, of the alkalinization of solutions of chlorhydrate of cocaine. He measures the an-

aesthetic gain. He also finds that the cocaine base is more active than the chlorhydrate but he is the first to show that the quantities of base set free by adding known quantities of soda are not sufficient for explaining the anaesthetic gain. He further finds that, by alkalinizing solutions of cocaine-base, in this case also there is obtained an anaesthetic gain which cannot be explained by the theory of O. Gros. He is therefore led to conclude that alkalinization increases the anaesthetic action not only by setting free the base (the only side of the question considered by O. Gros and the other authors above referred to) but also, and to a much greater degree, owing to the action of the alkali on the cell that receives the product, with a better fixation of the whole of the salt.

In 1933, Regnier and his associates (B. Sc. Pharm. 40 1933, 271, 650; 41 1934, 321) consider the question of the destruction of chlorhydrate of cocaine by heat and the ageing; he ascertains the following facts:

(*a*) the anaesthetic undergoes a destruction which is certain but relatively small, with a tendency toward a state of equilibrium;

(*b*) The solutions of chlorhydrate of cocaine that are prepared in such manner that after heating, the concentration in hydrogen ions is about pH=4 keep nearly the whole of their anesthetic power;

(*c*) When the solution of chlorhydrate of cocaine has been sufficiently acidified (pH≦3) their may occur failures in the anaesthesis, a fact that had already been observed by Regnier previously.

Starting from these observations, Régnier and David have prepared solutions of chlorhydrate of cocaine brought at a pH equal to 4 by means of various salts. They have thus found the fundamental fact that: the solutions mixed with sodium phosphates have, after heating, a very low anaesthetic power, while the solutions prepared with sodium acetate have, after heating a relatively high anaesthetic power. However, in both cases, the pH after heating was the same. I was therefore led to the conclusion that the acid of the salt mixed with the solution of chlorhydrate of cocaine plays an important part. I therefore prepared a whole series of solutions of salts of cocaine containing the same quantity of cocaine base as a 1% solution of chlorhydrate of cocaine and adjusted with the acid corresponding to the salt in such manner that the pH obtained may be equal to 4. These solutions were tested, before and after sterilization, on the cornea of a rabbit, according to the method described by Régnier in 1923 (B. Sc. Pharm. 1923, 30 580, 646) and I obtained wholly unexpected results in view of the admitted theories. These results are expressed by the following table:

	Fresh solution before sterilization	Solution sterilized for 15 minutes at a temperature of 120° C.
Citrate	[1] 0	
Tartrate	0.6	0.2
Sulphate	0.8	0.6
Phosphate	1	0.4
Chlorhydrate	1	0.8
Iodide	1.2	0.5
Sulphocyanate	1.5	0.6

[1] Does not penetrate at all.

Considering the order in which the salts that are studied are disposed, it is found that the activity of these salts before sterilization can be classed according to a series analogous to that found by Hofmeister, for the swelling of a gelatin or else (but however in the reverse order) for the flaking of an albumin.

It therefore results obviously from these experiments:

1. that the strength of the acid is not the only factor as stated by the theory above mentioned (O. Gros) because the salts are not classed in accordance with their degrees of hydrolysis;

2. that some acids (citric acid in particular) have an action which is quite unfavorable to the utilization of the alkaloid, so much so that citrate of cocaine does not permit, under the conditions of the tests, any appreciable anaesthesis, this solution being wholly unabsorbed by cornea;

3. that cellular lipoids are not the only factors in play, as would be the case according to the theory of Meyer and Overton, since the salts are classified according to a series which has been essentially found by Hofmeister on albuminoid substances.

It was therefore necessary to make experiments with other acids, and in particular acids having the property of acting on these albuminoid substances (swelling). The particularly interesting results of these new experiments, which were also new, are given in the following table:

	Fresh solution before sterilization	Solution sterilized for 15 minutes at a temperature of 120° C.
Formiate	2.5	1
Acetate	2.9	2.9
Salicylate	4	3
Benzoate	5	4.6

It therefore appears clearly that salts such as salycilates should be utilized, and especially benzoates, which posses, in fresh solutions, such an anaesthetic gain as could hardly have been hoped for, and preserve their anaesthetic power nearly entirely (in particular in the case of benzoate) after sterilization.

These facts therefore lead to pursue other experiments by making use of other acids capable of helping in the same way (and perhaps to a still higher degree) the properties above stated. It is again explained that these properties are: tensio-activity, easy adsorbability, favorable modification of the cellular electrid fields, increase of the swelling of the proteins, and as a rule everything that facilitates the penetration into the cell, according to what has been above explained.

Now that it has been proved that the favorable modification of the cell that receives the product by the acid that salifies the local anaesthetic plays so important a part in the physiological action, it is advisable to add to the anaesthetic gain that results from the utilization of a favorable salt another anaesthetic gain resulting from the use of other ions, which are also favorable.

Among these, use could be made of hydroxyl ions. This has not been done because it is known that in an alkaline liquor does not resist to heating and ageing. But it seemed that it was possible to make use of the favorable influence that potassium and magnesium ions exert, as it is known, on anaesthesis.

For this purpose, I made use not only of the pure saline solutions of the different salts of alkaloids but of solutions prepared for instance by mixing the local anaesthetic with accurately

calculated amounts of salicylates or benzoates of potassium or magnesium.

In this way I found that a solution of chlorhydrate of cocaine of 1% mixed with 2.5% of benzoate of magnesium, which solution had a pH substantially equal to 4, had, before sterilization, an anaesthetic value of more than 12%, that is to say the same anaesthetic value as a solution of chlorhydrate of cocaine of more than 12%; after sterilization for 15 minutes at a temperature of 120° C., its value was still 7 per cent; after having been preserved for two months and a half, six months, and eight months, the anaesthetic value became successively 7.6%, 4.6% and 4%.

The chief conclusion from the preceding explanations is therefore that the local anaesthetic activity of cocaine is very much increased when it is combined with acids which facilitate the reaction on the cell and still more when it is possible to combine together all the favorable conditions.

But it is known that chlorhydrate of cocaine penetrates already by itself with a sufficient facility through the protective layers of the nervous cells (epithelium of the cornea, of the mucous membranes) for which reason it is considered at the present time as the best local anaesthetic, in spite of its well known disadvantages.

It therefore became still more interesting to apply the conceptions to which one is led according to the present invention to the practical utilization of another local anaesthetic base, to wit novocaine, the generally employed salt of which, to wit the chlorhydrate (ordinary novocaine) does not permit, as it is well known, the anaesthesis of the mucuous membranes, of cornea, etc., so that, up to this time, novocaine was considered as devoid of practically any surface activity.

Repeating the experiments above stated, but replacing cocaine by novocaine, I prepared a solution of chlorhydrate of novocaine of 1% mixed with 2.5% of magnesium benzoate, having a pH of 4 and sterilized for 15 minutes at a temperature of 120° C. This solution was tested on the eyes of a rabbit, comparatively either with solutions of chlorhydrate of novocaine of various strengths, prepared extemporaneously in distilled water, or with solutions of chlorhydrate of cocaine of different strengths, prepared in the same manner. The following results were obtained:

The solution of chlorhydrate of novocaine of 1% mixed with magnesium benzoate and sterilized acts more effectively than a solution of chlorhydrate of novocaine of 30% in distilled water. A solution of chlorhydrate of novocaine of 1% mixed with magnesium benzoate and sterilized acts with the same efficacity as a solution of chlorhydrate of cocaine of 3% in distilled water.

It can therefore be stated that I succeeded in transforming novocaine in such manner that I have changed it into an excellent surface local anaesthetic. This fact, the practical importance of which is obvious, has already been tested in clinical experiments, in which a solution of chlorhydrate of novocaine of 5% mixed with magnesium benozate of 10%, the whole being sterilized and having a pH approximately equal to 4, has permitted of performing the same operatory interventions, in oto-rhino-laryngology for instance, as a non-sterilized solution of chlorhydrate of cocaine of 10% in distilled water. This fact, which corresponds to a local anaesthetic such as novocaine, which up to now had been considered as having no efficacity whatever as a surface ananesthetic, being so modified as to become a surface anaesthetic better than chlorhydrate of cocaine, can truly be considered as very remarkable. In view of the well known low toxicity of novocaine, this fact should render possible a new utilization, much more general of this anaesthetic. This technical result is all the more important as chlorhydrate of cocaine, which is so toxic and so dangerous because of its stupefying properties, is employed at the present time only because of its properties of surface local anaesthetic, which permit of employing it in cases in which it seemed impossible to replace it by other bodies, prior to the present invention.

I wish to insist more particularly on the remarkable property of the new salts or new mixtures according to the present invention of being sterilized or undergoing a substantial ageing while keeping most of their activity.

These advantages are due to two kinds of reasons:

1. To the fact that the pH of the solutions is always made substantially equal to 4, which, as above explained, is essentially favorable to the stability of the active molecule. This pH substantially equal to 4 remains within the necessary limits in order that the cell on which it is desired to act may not undergo any detrimental effect.

It should be further noted that the concentration in hydrogen ions is not the only factor to be taken into account in these phenomenons and it appears that the living cell can much more easily withstand a pH equal to 4 obtained with acids such as those the use of which is advised according to the present invention than a pH equal to 4 resulting from the ionization of mineral acids such as hydrochloric acid.

2. To the fact that the anaesthetic gain before sterilization being very high, it is maintained after sterilization and a substantial ageing, to a degree which remains extremely high.

To sum up, I rely, in the presentation of the present invention, on a combination of new facts, of a theoretical as well as practical nature which, briefly stated, are the following:

I. New theoretical facts

(*a*) The acids that serve to salify the local anaesthetic bases play a quite preponderating part for the anaesthetic action; they participate in this action, at least by facilitating the penetration of the salt into the cell;

(*b*) Everything takes place as if this favorable action was parallel to the influence exerted on the swelling of albuminoid matters (Hofmeister series).

(*c*) It is therefore quite likely that the proteic part of the cell is also brought into play in these phenomenons.

(*d*) If account is taken of the favorable influence probably exerted by the swelling of albuminoid matters, it seems possible to explain in the same manner the favorable influence exerted by the hydroxyl ions on the cell (Regnier) and perhaps alwso that exerted by the potassium ions for instance.

II. New technical facts

(*a*) By making use of the acids above proposed a better penetration of the salt is obtained and therefore a better utilization of the alkaloid. This obviously involves, since it is possible to employ weaker doses, a reduction of the toxicity and a reduction of the cost of the product employed, which is far from negligible. It even happens,

which in some cases is very much important that substances which, up to now, could not be employed for certain applications, due to their inactivity, are rendered perfectly active (utilization of novocain as a surface anaesthetic).

(*b*) With the acids that are proposed according to the present invention it is possible to employ a pH which is relatively acid (pH equal to 4) without injuring the cell, such a pH permitting a much better resistance of the anaesthetic to the causes of destruction involved by heating and a long preservation.

Considering, on the one hand, that the facts revealed by these experiments have an absolutely general value, and, on the other hand, that most of the alkaloidic salts are formed with strong acids, it is believed that the present invention covers in a general manner all the salts of alkaloids prepared with the acids above stated.

JEAN REGNIER.